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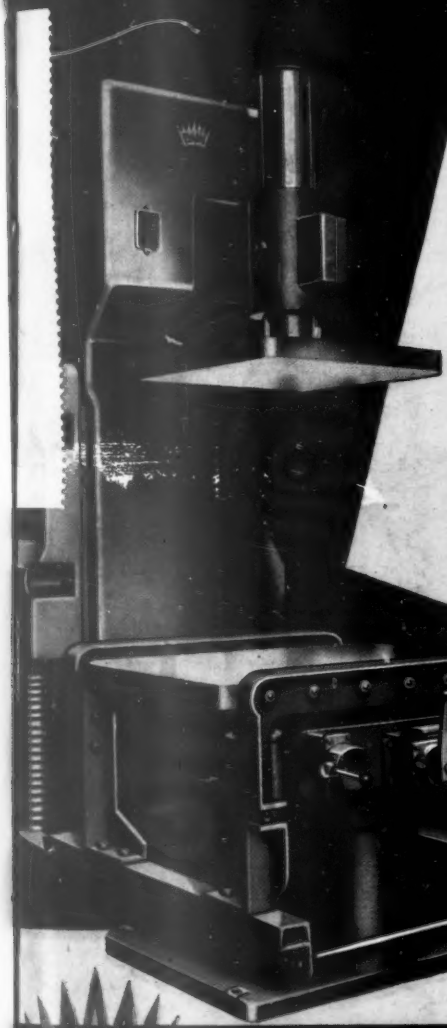

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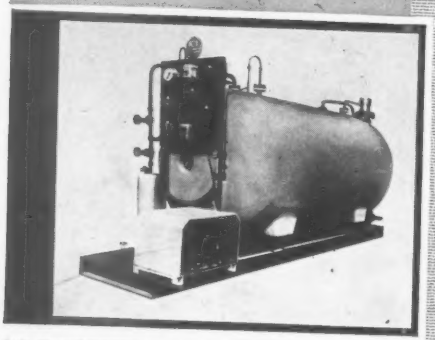

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Improving Non-ferrous Foundries

The First Report of the Joint Standing Committee on Safety, Health and Welfare Conditions in Non-ferrous Foundries* will be read with interest by all the executives of this important section of the foundry industry, if for no other reason than that such reports usually foreshadow legislation. Quite early in this rather-too-long Report there is a recommendation for the removal of the escape clause, which permitted, to certain non-ferrous foundries, a 14-month interval between wall and ceiling cleaning and its replacement by a six-monthly period. Other recommendations under the heading of "cleanliness" include the suggestion that walls should be smooth. In the house, Victorian *bric à brac* have been discarded because they were dust traps, and so, too, in new buildings should rough brickwork. Neither of the sections of the Report on "good housekeeping" nor "accident prevention" contain any reference to the "tiger-stripe" painting of protruding ends of machinery, such as the ramming heads of Sandslingers and Sandrammers, yet this system is very extensively—if not universally—used throughout Scandinavia.

A sensible and useful remark in the Report is given under the heading "Thermal Environment." It reads: "a reverberatory furnace can be used for the melting of aluminium for pressure-die-casting machines . . . (it) will give a fuel efficiency of about 30 per cent., whilst the bale-out furnace is about 15 per cent. . . . the reverberatory furnace can be so designed that it will improve conditions in the foundry to such an extent that there is no further heat problem." Reducing costs and improving working conditions makes an irresistible appeal; the subject is pursued at some length in appendices IV and V.

A substantial proportion of the Report follows on much the same lines as the "Garrett Report" and those who have followed the subsequent work of the various foundry organizations will find much repetition. There is a commonsense suggestion that where suitable canteens have been installed, the eating of meals in the shops should be prohibited. The use of open fires in the non-ferrous foundries is to be deprecated and discontinuance is recommended on the grounds that they create dirty conditions. Though the health hazard is referred to, we believe this, under the climatic conditions of this country to be innocuous. The Report does not differentiate between large and small concerns, which to our mind, it should. The provision of baths for a five-man concern is not, and never will be, an economic proposition, and the introduction of a suitable minimum size of foundry, below which such recommendations should not apply,

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SIR HENRY SPURRIER

Chairman, Leyland Motors Limited

Featuring . . . .

SIR HENRY SPURRIER

SIR HENRY SPURRIER is known as "Henry the Third"—the third Henry Spurrier to be chairman of Leyland Motors, Limited. His father, Henry the Second, together with James Sumner, started experimenting in Leyland's village blacksmith's shop; that was in 1895. Sir Henry's first recollections of the company are from about the age of eight, when his father used to take him, during school holidays, to the little engineering shop, having then perhaps 40 to 50 men in all. They were building steam wagons, and making every part except the oil lamps. The firm, known as the Lancashire Steam Motor Company, had already acquired a good reputation for the quality and reliability of its wagons. As a boy, he was fascinated by all that could be done in this workshop, and was soon making his own brass castings—the favourite being a model cannon. Kindly workmen taught him how to machine and finish this in a lathe, and finally how to make a little wooden gun-carriage, on wheels. Then came the great day when the cannon was fired with real gunpowder and a lead cannon-ball.

By the time Henry Spurrier left school he knew how to work and use nearly all the machines and tools that were to be found in the Leyland shops, which by then had grown considerably and employed several hundred men. His real apprenticeship was interrupted by the 1914-1918 war, when he left to become a pilot in the R.F.C. with which he remained until 1919.

For the next 20 years he worked his way up through most departments of the firm, and by the time world war II began he was in the position of assistant general manager. His father's death, early in 1942, was a great blow to him, and, in fact, to all at Leyland—Henry the Second was a remarkable man, and loved by everyone who knew him. By this time Leyland had turned its shops over to the production of tanks, and before the war finished the company was to become responsible for the design and group production of the latest Cromwell and Comet high-performance tanks.

Sir Henry's post-war story has been, very largely, one of developing a world-wide market for Leyland 'buses and trucks. The firm has multiplied its output many times over the pre-war figures, and to-day employs some 20,000 people. Other post-war "highlights" include the building and running of a huge tank factory alongside the main works—to provide Centurion tanks for the Government, against an urgent rearmament policy. The tanks are no more required, and the factory now makes Leyland diesel engines in large numbers. Five years ago, the firm amalgamated with Albion Motors, Limited, of Scotland, and three years later with Scammell Lorries, of Watford.

One man does not accomplish any of these things alone. Sir Henry is the first to praise a brilliant team of executives around him—each, without exception, having worked his way to the top from a humble start with Leyland. To himself, however, Sir Henry takes some credit only for having recognized their qualities, and for having picked them out. Leyland has been his "life" for over 50 years, and all still regard it as a "family affair."

(According to *Who's Who,* Sir Henry's sole recreations are sailing and shooting.)

Improving Non-ferrous Foundries

would save the factory inspectorate of the future much trouble in assessing where and when exemption should be granted. When considering the introduction of rules, regulations, and codes of practice into foundries it is always well to bear in mind the divergent necessities according to size range—fewer than 10 men, up to 50, 50 to 150, and above 150—for example. It can, however, be stated, quite unreservedly, that this is an excellent Report and there is much in it for every type of foundry.

National Castings Council USA

The American National Castings Council, composed of 11 societies and associations, in the foundry and allied industries, held its annual meeting in Chicago, last month. The programme included a visit to the foundry exhibit of the Museum of Science and Industry; reports on new activities of several member organizations, and discussions of problems created by actions in Washington; one of these, the continued high export rate of high-quality scrap, especially the heavy melting grades, was deplored. Council members expressed concern over possible curtailment of the Business and Defence Services Administration, through cuts in the budget; it was felt, in addition to being the one point in government where business has a voice, the BDSA is most important as a planning agency for possible future emergencies. Upon the unanimous vote of the Council representatives, a telegram was sent to Senator Spessard L. Holland, chairman of the Senate sub-committee on Appropriations for the Department of Commerce, advocating its continuance. The Council represents no fewer than 6,000 business enterprises.

Officers of the Council were elected as follows: President: Mr. Bradley B. Evans, sales manager, Empire Steel Castings, Inc., Reading, Pa., and president, Alloy Casting Institute; vice-president: Mr. Howard F. Park Jr., vice-president, sales, General Steel Castings Corporation, Granite City, Ill., and president, Steel Founders' Society of America; Treasurer: Mr. F. Ray Fleig, president, Smith Facing & Supply Company, Cleveland, and Secretary: Mr. Frank G. Steinebach, vice-president and secretary, Penton Publishing Company, Cleveland.

OEEC Zinc Production

Total refined zinc production for OEEC producer countries (Austria, Belgium and the Belgian Congo, France, Germany, Italy, Netherlands, Norway, and the UK) amounted to 73,284 metric tons in May, compared with 71,013 metric tons in the previous month. The breakdown into qualities of last month's production was:—High-grade and special high-grade zinc (at least 99.95 per cent. zinc content), 26,918 metric tons; others (g.o.b., debased), 46,366 metric tons.

IT IS ANNOUNCED by the Institution of Production Engineers, that a specialist group on materials handling has been formed within the Institution, under the chairmanship of Mr. A. G. Hayek, M.I.Prod.E., of A. G. Hayek & Partners, Limited, Stoke-on-Trent. The main activities of the group will be the organization of conferences and lecture meetings; the preparation of case-studies for publication, and the establishment of working groups.

Dinner

INSTITUTE OF BRITISH FOUNDRYMEN

At the annual dinner of the Institute of British Foundrymen held during conference week at Harrogate, the new president, Mr. J. Blakiston, took the chair. Members and guests occupying table "A" included distinguished personalities of the foundry and kindred industries, amongst whom were: the Mayor of Harrogate (Councillor Miss A. Wardle, J.P.); G. M. Menzies; the Mayoress of Harrogate (Miss N. Tagg); Sir Edward A. Anderson, J.P.; H. J. V. Williams; T. Swaminathan; N. P. Newman, J.P.; A. E. Peace; G. E. Lunt; J. H. Rylands; P. B. Higgins; J. J. Sheehan, B.Sc.; K. Marshall; J. L. Hepworth; Dr. A. H. Sully, M.Sc.; C. H. Wilson; D. E. Catton; G. Blanc; R. W. Asquith; Dr. A. B. Everest; Dr. C. J. Dadswell, B.Sc.; A. Blondel; W. R. Blakeborough; V. C. Faulkner; D. H. Wood; J. E. Hurst, C.B.E., J.P., D.Met.; C. Gresty; D. Sharpe; E. Longden; G. D'Arcy Nash; C. Robertson; John Bell; G. P. Dahm, and Richard W. Asquith, M.C.; most of these were accompanied by their ladies.

After the Loyal Toast, the toast of "The West Riding of Yorkshire" was proposed by Mr. H. J. V. Williams and the response given by the Worshipful Mayor of Harrogate. "The Institute of British Foundrymen" was proposed by Mr. G. M. Menzies and Mr. J. Blakiston replied. The toast to "The Guests" was presented by Mr. A. E. Peace and the response was by Sir Edward A. Anderson, J.P. After dinner, the function continued with cabaret and dancing until 1 a.m.

Mr. Charles H. Wilson (pictured below) was elected junior vice-president of the Institute of British Foundrymen at the annual conference. Biographical notes were published in this JOURNAL *on June 27.*

Improving the Mechanical Properties of Cast Steel*

By B. B. Guljajew

Divers qualities demanded from steel castings are placing a heavy burden on the foundry industry. Therefore, it is essential that founders be fully cognizant of technological and production methods, which enable them to produce high-quality castings with low scrap rates. The Author, in dealing with defects that commonly occur, has portrayed, by means of tables and graphs, their effect on the mechanical properties of steel castings, and concludes by indicating the usual manner in which these defects are overcome.

Mechanical engineers and designers are continuously making higher demands on the mechanical properties of steel castings. Modern machines and tools work at increasingly higher speeds and temperatures, and are additionally subjected to complex loadings and diverse corrosive media. It is obvious that if the founder is to widen his sales market, then he has to place careful consideration on the mechanical properties of his castings, in addition to normal control, to ensure sound and dimensionally accurate products.

TABLE I.—*Mechanical Properties of Step-forged Test-specimens.*

Ratio cast:forged cross-sectional areas.	Location of specimen.	Mechanical Properties. SAND-CAST: Tensile strength, tons per sq. in.	SAND-CAST: Reduction in area, per cent.	SAND-CAST: Impact Value mkg.	CHILL-CAST: Tensile strength, tons per sq. in.	CHILL-CAST: Reduction in area, per cent.	CHILL-CAST: Impact Value mkg.*
1.0	Surface	58.5	43.5	5.6	57.8	46.7	5.5
	Half-radius ..	58.0	29.5	5.4	56.6	31.5	5.0
	Axis	56.6	20.0	—	—	—	—
1.25	Surface	54.8	46.7	7.2	55.6	50.3	6.7
	Half-radius ..	55.7	47.2	—	56.0	57.6	6.7
	Axis	55.8	31.0	8.5	—	—	—
1.50	Surface	58.9	62.7	—	57.4	55.0	9.4
	Half-radius ..	58.4	55.9	—	56.7	60.5	—
	Axis	57.7	51.5	—	—	—	—
2.0	Surface	59.1	62.8	—	57.4	66.5	—
	Axis	55.0	26.0	—	57.1	64.7	—
4.0	Surface	58.9	66.2	—	56.0	58.4	—
	Axis	—	—	—	56.3	66.4	—

(1.0 metrekilogram is equivalent to approx. 7.23 ft. lb.)

Effect of Forging

Table I gives the variation in mechanical properties of two 66-lb. cylindrical test-castings, one of which was sand-cast, the other cast in an iron mould. Each of these specimens were then progressively forged, in steps of varying reduction, one step being left in the "as cast" state. Elongation, after tensile tests (Gargarin), was noted, and the impact value (Mesnager) determined for each of the reduction steps. In order to obviate the tempering effect of the forging temperature, the prepared specimens were heat-treated before finishing. Referring to Table I, it will be seen that the plasticity of steel in the as cast condition is appreciably less than in the forged state. A small reduction in cross-sectional area (20 per cent.) is sufficient to cause a noteworthy increase in mechanical properties, whilst further reductions had only insignificant effect. It should be noted that the plasticity of sand-cast steel is less than chill cast, despite the fact that the latter specimens contained numerous casting defects, unconnected with solidification conditions.

If steel, in the cast and forged states, have the same tensile strength, it is usually found that the cast steel has a lower plasticity and impact strength; plasticity is also reduced when the metal remains in the solidification range for any length of time—due to the porosity that results under these conditions.

Alloying Additions

Fig. 1, compares the effect of tensile strength on elongation, for certain specified compositions; points on the curve correspond with the steel specifications, based on Russian and other foreign standards (these are designated in the key, see caption Fig. 1). Curves 1 to 5 show that demands for tensile strength have risen from the range of 22.0 to 31.5, to a range of 28.5 to 41.2 tons per sq. in., in the last 20 years. It is interesting to note that the Russian standards for steel castings are more stringent, as regards mechanical properties, than those called for by Germany, England and the USA. The most important curve is 6, which is compiled from Russian cast-steel standards, in which a differentiation is made between a hardened and tempered casting, and one which is normalized and tempered. The circles connected by a full line

* Translation of a paper from the symposium *Hochwertiger Stahlguss* (High-grade Steel Castings) made available to this JOURNAL by courtesy of the director of the British Steel Castings Research Association.

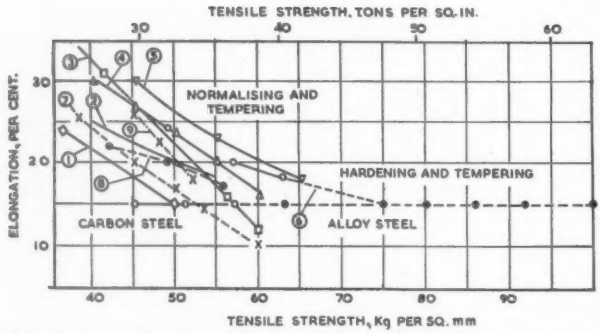


FIG. 1.—*Relationship between elongation and tensile strength for different steels, heat-treatments, of steel castings according to different specifications:* (1) *OST* 971 1930; (2) *OST* 7504/152 1935; (3) *OST* 26-050 1940; (4) *GOST* 977-41 1941 (*at present valid*); (5) *Draft GOST* 1950; (6) *Standards* 353-48 1948; (7) *German Standards* 1948:8; (8) *American Standards* 1946; (9) *British Standards* 1950.

give the stength values for unalloyed, whilst those connected by a dotted line are for alloyed castings. The effect of alloying additions on tensile strength can be visualized, if it is remembered that whereas 41.0 tons per sq. in. can be attained for a plain-carbon steel, figures of 63.0, and even higher, are normal for alloy castings. The influence of additions is even more marked in the case of forgings.

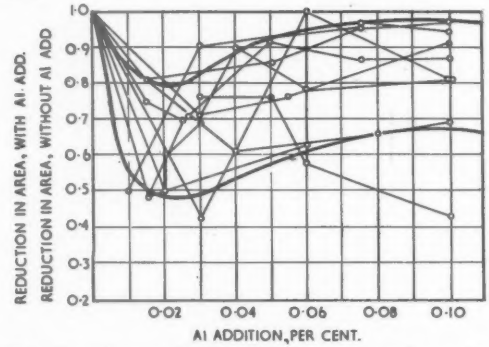


FIG. 2.—*Change in the plasticity of steel on deoxidation with different proportions of aluminium (data from various sources).*

Table II gives the results of an investigation of cylindrical cast-specimens of 3.1-in. dia., which

TABLE II.—*Mechanical Properties of Three Steels cast in Ceramic Moulds.*

Steel.	Process of steel-making.	Location of specimen.	PROPERTIES	
			Tensile strength, tons per sq. in.	Reduction in area, per cent.
Cr/Ni/Mo	Acid ..	Surface ..	63.3	30.4
		Half-radius	59.0	15.4
		Middle ..	—	—
Cr/Mo	Acid ..	Surface ..	50.2	29.1
		Half-radius	58.5	16.6
		Middle ..	56.5	9.0
	Basic ..	Surface ..	64.4	30.5
		Half-radius	60.96	14.5
		Middle ..	—	—
Unalloyed steel ..	Basic ..	Surface ..	48.0	33.4
		Half-radius	45.7	16.7
		Middle ..	41.2	10.0

were poured vertically in ceramic moulds. Specimens were taken parallel to the pouring axis, machined, heat-treated and polished (as a result of the heat-treatment, the same plasticity was attained in the unalloyed, as in alloyed steel). It will be seen that for the same plasticity, tensile strength of carbon steel was about 25 per cent. less than that of the alloy steels. This table also indicates the problem of heterogeneity that is sometimes observed in steel castings. At the half-radius position, the strength falls 7 to 10 per

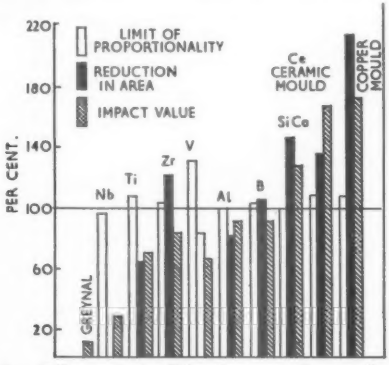


FIG. 3.—*Effect of modification on the mechanical properties of cast steel.*

cent. and the plasticity by 70 per cent., from those values determined in the surface zone.

Russian foundrymen have developed a large range of compositions for castings alloyed with chromium, nickel, copper, molybdenum, manganese, silicon, etc., having high mechanical properties combined with good foundry qualities. The properties of some of these steels are listed in Table III, the results having been obtained from experiments carried out on specimens of 1½-in. thickness.

Heat-treatment

The safest method of improving the mechanical properties of a steel casting is to add alloying elements; however, considerable effect can be gained by various heat-treatments, as shown in Table IV, which tabulates experimental data for a typical carbon steel. This steel was melted in an acid-lined electric-arc furnace, and cast as cruciform section

TABLE III.—*Composition and Properties of Russian Special Steels*

Steel type.	Chemical composition, per cent.									Properties. Normalized and tempered.				Hardened and tempered.			
	C	Si	Mn	P (max.)	S (max.)	Cr	Ni	Mo	Cu	Tensile str'gth, tons per sq. in.	Elongation per cent.	Reduction in area, per cent.	Impact, mkg. per sq. cm.	Tensile str'gth, tons per sq. in.	Elongation per cent.	Reduction in area, per cent.	Impact, mkg. per sq. cm.
ж40Х ..	0.35 0.45	0.25 0.45	0.50 0.80	0.04	0.04	0.80 1.10	0.50	—	—	—	—	—	—	31.7	15	25	3.5
ж20Х ..	0.15 0.25	0.25 0.45	0.50 0.80	0.04	0.04	0.80 1.10	0.50	—	1.40 1.60	25.3	15	25	3.0	34.8	15	25	4.0
ж35ХМ ..	0.30 0.40	0.25 0.45	0.50 0.80	0.04	0.04	0.80 1.10	—	0.20 0.30	—	25.3	15	25	3.0	34.8	15	25	4.0
ж36НТМ	0.32 0.42	0.25 0.45	0.80 1.20	0.04	0.04	0.30	1.00 1.50	0.15 0.25	—	—	—	—	—	38.0	15	25	4.0
ж30ХНМ	0.28 0.35	0.25 0.45	0.50 0.80	0.04	0.04	1.30 1.60	1.30 1.60	0.20 0.30	—	34.8	15	25	3.0	41.2	15	25	4.0

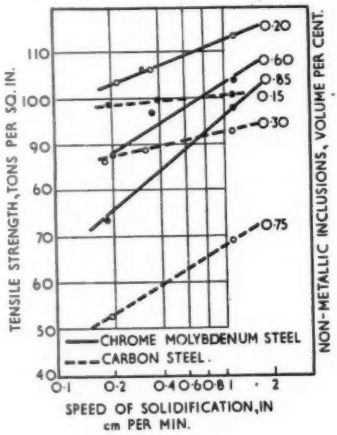


FIG. 4.—*Effect of speed of solidification and content of non-metallic inclusions upon tensile strength.*

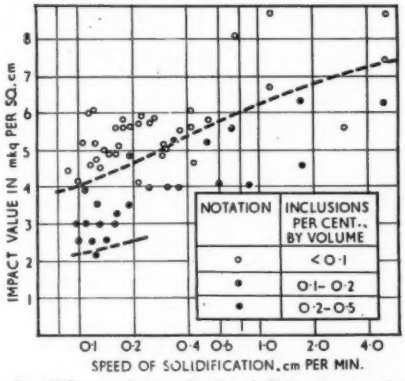


FIG. 5.—*Effect of speed of solidification and non-metallic inclusion content upon impact values.*

test-pieces; each value is the average obtained from 16 specimens, each of four melts. It will be noted that the plasticity values and impact strength were improved by hardening and tempering (for alloy steels heat-treatment is deemed to be an essential).

For cast specimens with small and medium sections, a preliminary heat-treatment has little effect; for thick sections, in alloy steels, however, homogenizing and normalizing, prior to hardening, notably raise the plasticity and toughness, Table V shows the variation of properties when a Cr/Ni/Mo cast steel, melted in a basic open-hearth furnace is subjected to a range of pre-heat-treatments.

Each value is the average of eight determinations on specimens cast 4¼-in. dia.

The effect of mass on heat-treatment cycles must always be considered, especially where the casting is of thick section; experimental work has advanced the practice of heat-treatment of large and complex castings, and has confirmed the necessity of general adoption of hardening, or at least normalizing castings for higher strength.

A characteristic individuality of steel castings is

TABLE IV.—*Improvement of Properties Through Heat-treatment.*

Heat treatment.	Tensile strength, tons per sq. in.	Yield point, tons per sq. in.	Elongation, per cent.	Reduction in area, per cent.	Impact strength, mkg per sq. cm.
Normalized at 900 deg. C.	39.8	23.1	20.6	39.4	4.3
Normalized at 900 deg. C. tempered at 670 deg. C., cooled in air	36.0	21.3	22.8	44.7	5.0
Normalized at 900 deg. C., oil hardened from 870 deg. C., tempered at 670 deg. C., cooled in air	38.9	27.3	23.2	47.5	6.8
Normalized at 900 deg. C., air hardened from 870 deg. C., tempered at 670 deg. C., cooled in air	40.0	29.5	23.5	50.7	7.0

Improving Cast Steel

the considerable effect of the conditions of solidification on their structure and properties. This affords to foundrymen the possibility of adjusting the moulding techniques, to improve properties of the eventual casting. Melting procedure and characteristics of the molten steel play an important part, in assuring high quality—the larger a casting, and the longer it takes to solidify, the

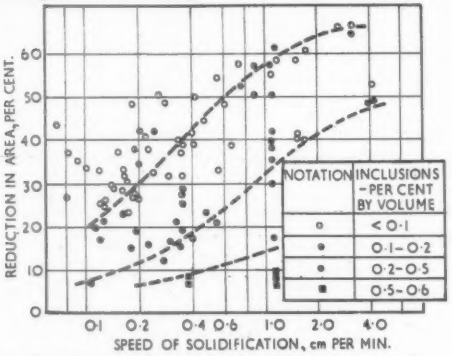


FIG. 6.—*Effect of speed of solidification and non-metallic inclusion content upon the reduction in area.*

greater will be the influence of the quality of the molten steel. For example the lower the gas content, non-metallic inclusion and dangerous impurities, the greater the plasticity and tensile strength, by obviating high-stress points and porosity. Casting temperature has some influence, for an increase will lead to a more marked development of the dendritic structure and to a slight increase of the plasticity. For alloy steel this influence is readily shown, whilst a plain carbon steel exhibits negligible effects; this does not mean, however, that steel must be cast at the highest possible temperatures, since an undue increase in casting temperature leads to hot-tearing, porosity and chemical heterogeneity, resulting in a considerable deterioration of the mechaincal properties.

Effect of Deoxidation and Modifiers

The deoxidation process in steel casting has a large influence on the plasticity. Fig. 2 illustrates the effect of aluminium content, used for deoxidation, on the ductility of steel, and shows that a content of 0.01 to 0.04 per cent. aluminium markedly reduces the ductility by as much as 36 per cent. Only recently has the expedient of modifying castings for constructional steel been recognized. It is within the last year that it has become clear how effective modification can be achieved, and the subject is still a matter for considerable research. Fig. 3 shows the effect of several modifiers on the mechanical properties of Cr/Ni/Mo steel castings, melted in a 1 cwt. induction furnace and poured in ceramic moulds, as cylindrical specimens of 22-lb. weight and 3.1-in. dia. A control test, without a modifier, was cast from each melt, modifiers were then added in stepped amounts to the remaining steel. The properties of the cast specimens, with optimum content of the modifiers, are also shown. Specimens for mechanical tests were taken at the mid-radius point of the casting; all properties are expressed as ratios of those without modifier additions. Modifiers can be divided into three groups based on their effect on the properties:

(*a*) Strength, plasticity and toughness reduced (addition of "Greynal" and niobium).

(*b*) Plasticity and toughness insignificantly reduced (titanium, zirconium, vanadium, aluminium, and boron).

(*c*) Plasticity and toughness raised (calcium/silicon and cerium [apparently metallic cerium produces a beneficial effect]).

TABLE V.—*Variation of Properties with Pre-heat-treatment.*

Preliminary heat-treatment.	Properties after hardening and tempering. Tensile strength, tons per sq. in.	Yield point, tons per sq. in.	Reduction of area, per cent.	Impact strength, mkg. per sq. cm.
None	49.8	41.9	17	3.8
5 hours heating at 920 deg. C.	52.0	48.2	21	4.5
Normalized at 920 deg. C.	59.0	45.7	21	4.2
5 hours heating at 920 deg. and normalized from 920 deg. C.	61.6	47.6	21	4.3
15 hours homogenising at 1,100 deg. C. and normalized at 930 deg. C.	51.4	40.6	43	6.7

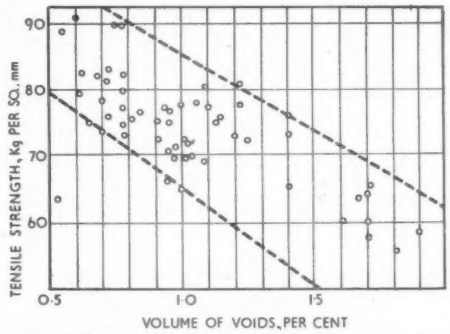


FIG. 7.—*Effect of porosity (volume per cent. determined by density measurements) on the tensile strength of a steel casting.*

Good results were obtained with magnesium, at first, but a systematic investigation with this element had to be abandoned on account of the danger arising from its inflammability. Experimental values led to the conclusion that modification with Ca/Si and cerium are very promising. It is interesting to note that the addition of certain modifiers (*e.g.* boron) alter the structure markedly but do not improve the mechanical properties, whilst they are improved by cerium and calcium with no apparent alteration of the structure; from this it follows that the influence of modifiers on

the structure is not directly related to their influence on properties.

Speed of Solidification

A fundamental technical factor which has a decided influence on the structure and properties of steel castings is the speed of solidification. Figs. 4, 5, and 6 show the relationship between the strength, plasticity, and impact strength of steel castings, and the speed of solidification and volume content of non-metallic phases (the speed of solidification is a caluclated figure). The figures show

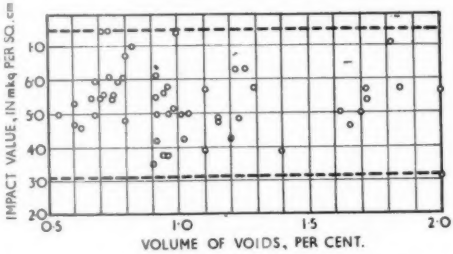


FIG. 8.—*Porosity effect on the impact value of specimens from different sections of a steel casting.*

the marked decrease in the plasticity; less decrease in toughness and negligible decrease in tensile strength resulting from slow solidification. Properties of castings, with slower solidification, decrease as the content of non-metallic phases is reduced. In estimating the effect of non-metallic phase content, it must be remembered that it rarely exceeds a value of 0.1 to 0.2 per cent., which results in negligible influence on tensile values and plasticity. The most common non-metallic phases in steel are sulphides, which are characterized by heterogeneous

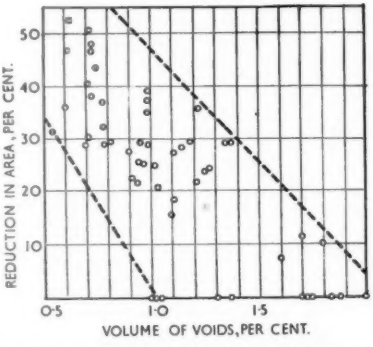


FIG. 9.—*Effect of porosity on the reduction in area in a plain-carbon steel.*

distribution throughout the cross section of the casting. In regions of high sulphide content, a local decrease in ductility is observed, this can be minimized by increasing the freezing rate, which results in a more uniform distribution of these inclusions, together with a refinement of structure, and a reduction of porosity.

The speed of solidification can be increased by casting in metal moulds, or providing additional chills, which are usually located near zones of greater cross section, to avoid differential cooling rates which are liable to produce localized porous structure, and zones of high stress.

Location of Feeder Heads

When feeding a section is difficult, a porous structure results which is accompanied by a drastic reduction of mechanical properties. Figs. 7, 8, and 9 show the relationship between the tensile strength, impact value and plasticity and the volume concentration of voids, determined by density measurements. From these, it is clear that with an increase in the volume of voids from 1 to 2 per cent., the plasticity of the steel falls to zero and the strength by 50 per cent., as a result of embrittlement. The

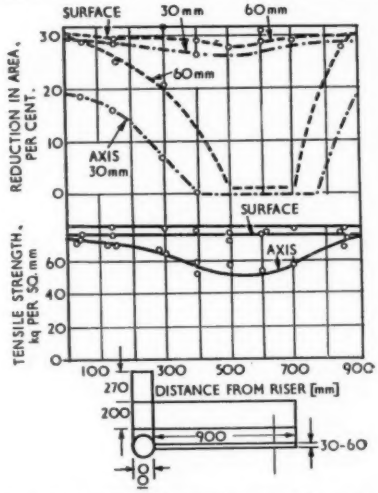


FIG. 10.—*Variations in tensile strength and reduction in area compared with the distance from a feeder head, samples having been taken from the axis of cylindrical casting.*

impact strength, within the scatter band of this property, does not depend upon the porosity. From this it appears that a steel casting is capable of meeting demands for resistance to impact, even when the material is unsound, from the point of view of porosity. This porosity will increase the further the molten steel has to travel in feeding the casting. A demonstration of this is given in Fig. 10, which shows the variation of the mechanical properties in a flat casting of chromium/molybdenum steel, where plasticity falls sharply and tensile strength also decreases with increasing distance from the feeder heads. It is clear that in order to minimize porosity, risers and feeder heads must be spaced at relatively small intervals, dependent upon the volume of the casting.

Improving Cast Steel

Mould Design

An effective means of reducing porosity is to mould walls of the casting with a conical taper. Fig. 11 shows the effect of such a taper on the properties; it can be seen that as the angle of the taper is increased, the plasticity of steel is more than doubled, and the strength is also somewhat increased. Simultaneously with the appearance of porosity, the flow of liquid steel into the solidifying portion of the casting produces a V-shaped segregate which similarly, adversely affects the mechanical properties. The diverging branches of the V-shaped segregate are always directed to the location of the feeding point, irrespective of its location. The nearer this point in the casting is to the feeder head, and the more lively the motion of the replenishing steel, the more developed is this kind of segregation, and the greater the decrease in plasticity.

"Pipe" and Feeding Methods

The removal of "pipe," which is one of the more important tasks of foundry techniques, implies the maximum shortening of the path of molten steel

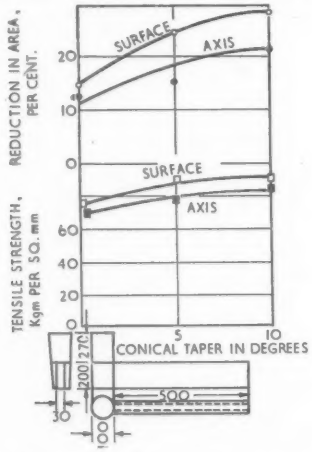


FIG. 11.—*Effect of increasing degree of taper, in a mould, on the tensile strength and reduction in area.*

to the various portions of the casting. Fig. 12 sets out the variations of the mechanical properties of several cross sections of a casting with difficult feeding. A series of specimens were cast without any means of improving the feeding, whilst another set were poured in moulds with chill plates. From the castings, which were solidified without chills, not one specimen, from the axis of the sand mould castings, could be tested, since these specimens always broke during machining. The influence of chills on the thicker sections enabled specimens possessing good mechanical properties to be produced.

Another suitable means of reducing the porosity, and raising the plasticity, of the axial region of a casting is feeding under pressure. Table VI gives the experimental results of properties of castings which were poured in identical moulds, but under different feeding conditions, *i.e.* by normal open feeding; a blind feeder with a core for the supply of air at atmospheric pressure; with a gas cartridge and with pressurized feeding by compressed air (after the method used at the Bolshevik works). The tabulated values are the average of 16 experimental measurements.

TABLE VI.—*Mechanical Properties of Castings with Different Feeding Methods.*

Thickness of casting, ins.	Method of feeding.	Tensile strength, tons per sq. in.	Reduction in area, per cent.	Impact strength, mkg. per sq. cm.	Porosity, per cent.
1.21	Open head ..	51.1	13.8	4.83	1.20
	Atmospheric head	48.0	9.6	4.79	1.18
	Gas pressure ..	50.8	15.8	4.93	1.10
	Compressed air ..	54.3	21.0	5.53	0.97
2.3	Open head ..	54.9	21.0	5.60	0.82
	Atmospheric head	51.2	16.5	4.57	0.87
	Gas pressure ..	55.7	19.5	5.50	0.52
	Compressed air ..	58.0	26.8	5.65	0.50
5.9	Open head ..	61.9	20.6	4.55	0.257
	Atmospheric head	63.4	14.0	4.55	0.248
	Gas pressure ..	63.0	15.5	4.35	0.194
	Compressed air ..	60.7	24.0	4.55	0.146

It will be seen that the feeding with an atmospheric head is somewhat less than that obtained with the normal head, castings with compressed-air and gas pressure-feeding possess reduced porosity with subsequent enhanced plasticity. Good feeding through the correct placing of feeder heads; increasing the conical taper; employment of chill plates; and feeding under pressure, utilizing gas or air are all responsible for improving mechanical properties of castings.

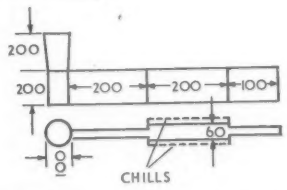


FIG. 12.—*Variations in tensile strength of several cross sections of a long, cylindrical casting fed from one end.*

Conclusions

To guarantee the quality of casting it is necessary to attempt to simplify the design, and to know how to apply the various technological methods of improving mechanical properties. If the founder is to avoid producing reject castings, he must assure that both metallurgical and production techniques are such that pouring, feeding, and chilling are correctly facilitated, in order to reduce the incidence of cavities, porosity, heterogeneity, and inclusions of non-metallic particles.

(*Concluded on page* 12)

Clean Air Act

Further Consideration of the Ironfounding Industry's Case for Special Treatment

The public hearing by Sir Frederick Armer of applications by a number of industries for treatment as special cases under the Clean Air Act concluded on June 20 after nine days had been so employed. The earlier sessions, at which the ironfounding industry applied for such treatment, have already been reported in this JOURNAL (June 6 issue, page 705) and what follows are extracts from the more recent proceedings. (Sir Frederick's report to the Minister of Housing is now awaited).

The Joint Iron Council's submissions, in respect of the melting of iron and steel in the cupola furnace, were fully supported by a representative of the British Transport Commission, Mr. George Oldham (assistant works manager, Crewe Locomotive Works) on the sixth day of the inquiry. The Commission asked that its iron and steel foundries and power-houses at the principal railway workshops should come under a central technical control for the purpose of securing for them uniform treatment under the Act.

Local Authorities' Case

Applications on behalf of the local authorities were heard on the last two days of the inquiry. The organizations represented were the Association of Municipal Corporations, the Sheffield and District Clean Air Committee and the West Bromwich Borough Council.

The Association of Municipal Corporations had submitted that "the list of works in the First Schedule to the Alkali Act, 1906 and of noxious or offensive gases in section 27 of that Act should not be extended." It had been understood that the case would be put in purely general terms and that the matter would not be contested industry by industry upon technical grounds because local authorities did not question the fact that there were industries which presented technical difficulties upon which the advice of experts was necessary. Mr. H. P. Stirling, Counsel for the Association, said at the outset that they were very much concerned in the interests of the public that local authorities should retain the widest possible control and powers in the problem of the control of smoke, grit and dust. In his submission the proposals of the industrialists* were much too wide and the Association had come to the conclusion that if they were to be embodied unmodified in an Order this would result in an unwarranted diminution in the powers of the local authorities. Mr. Stirling said: "The Association of Municipal Corporations have always felt very strongly that. in the last resort, the local authorities should have an unfettered right to initiate proceedings for breaches of the Clean Air Act, and we say that in the vast majority of cases the local authorities are the people who can best deal with unsatisfactory local conditions in regard to air pollution; and I think I may say we object very strongly to any tendency to reduce the rôle of local authorties to that of smoke watchers."

Referring to the submissions by the Joint Iron Council and the evidence which had been given on the cupola, he recalled that the hot-blast cupola had been described as a most effective suppressor of grit and dust and that the one remaining problem—that of fume emission—was not very great and on the way to being overcome.

Mr. K. Marshall (director of the Joint Iron Council), replying, quoted extensively from the evidence which had been given by Dr. J. G. Pearce and Mr. W. Brindley, and in particular recalled Mr. Brindley's statement that "so far as I can see there is no solution to that problem" (of fume emission) and Dr. Pearce's warning against regarding the hot-blast cupola as a solution to the problem of dust emission from the cupola furnace. Mr. Marshall said it was necessary to put earlier statement in its full context lest the sentence quoted from Mr. Stirling might otherwise be misleading if it were treated in isolation.

Evidence from Sheffield

The Sheffield and District Clean Air Committee had submitted that "the existing list of works scheduled under the Alkali Act should not be extended, in so far as an extension would affect the areas of local authorities who employed an adequate and efficient Inspectorate and had adequate technical and other resources." Mr. T. Holt, for the Committee, described the constitution of the Sheffield and District Clean Air Committee, which covered Sheffield, Rotherham, Rawmarsh and Stocksbridge. He spoke of the number and qualifications of the staff employed (a chief smoke inspector and four district smoke inspectors, all trained engineers) and the close association with all relevant research work, particularly with that sponsored by the Committee and carried out in the Department of Fuel Technology of the University of Sheffield. Mr. Holt submitted that the Alkali Inspectorate must lack the specialized local knowledge and the local "know-how" of a local inspectorate, and that it would be unrealistic to suppose that the Alkali Inspectorate had beneath their direct control laboratories and all the resources needed for research into particular problems. If the Chairman were not satisfied with the case made by the Association of Municipal Corporations, Mr. Holt asked that he should make a very firm representation that the Minister should promptly and fully exercise his discretion under Section 17(2) of the Clean Air Act in favour of those local authorities who themselves employed competent smoke inspectors.

* Applications were made in respect of iron and steel manufacture, copper works, non-ferrous metal recovery, power-stations, gas-works, and industrial gas plants, and ceramic, lime and chemical works.

Clean Air Act

Smoke Inspector's Views

Mr. J. W. Batey (Chief Smoke Inspector of Sheffield) was examined by Mr. Holt and he expressed the opinion that in a large amount of the evidence there had been a gross exaggeration of the difficulties which remained in regard to air pollution. Asked by Mr. Holt to give an example, Mr. Batey said it had been suggested, for instance, that every cupola had its own problems but that another witness had stated that there was a piece of apparatus which could be fitted to any cupola. Mr. Batey said: "I would agree with that second statement. There is a piece of apparatus which can be fitted, which does not affect the efficiency by any means, but none the less it is a step on the road to 100 per cent. efficiency. There is no remarkable problem on cupolas." In cross-examination Mr. Batey agreed that his inspectors had no qualifications giving them special knowledge in regard to metallurgical techniques of iron and steel plants, and he had not had any responsibility for an iron works. He said that he would disagree if somebody said it was extremely difficult, if not a serious problem, to fit a piece of apparatus to a cupola to arrest the dust and grit. His inspectorate had some practical experience in the fitting of this apparatus to suppress dust. In reply to further questions Mr. Batey agreed that there was no complete solution to the problem of grit and dust emission and he did not think there was any solution in this country to the problem of fume emissions from hot-blast cupolas. Re-examined, Mr. Batey was asked if the arrestment apparatus he had referred to although it might not provide a 100 per cent. answer to every problem, did provide a substantial improvement; he replied that that was so; it had to be tailored to the local requirements, but, in general, it was a standard piece of apparatus.

Sir Frederick Armer said: "As I understand your evidence, Mr. Batey, what you are really suggesting is that if all the authorities had staff like Sheffield there would be no need to schedule these processes under the Act?"

Mr. Batey agreed this was his suggestion.

West Bromwich and Scheduling

The West Bromwich Borough Council submitted that only in a very few special cases where there were really special technical difficulties should scheduling take place. Mr. E. Thomas, on behalf of the West Bromwich Council, said the industries in the borough included ferrous foundries. With the passing of the Clean Air Act the Authority had organized itself to deal with it by appointing specially qualified staff. Scheduling of the processes proposed by industry could involve the transfer of 85 factories and works in the borough to inspection by the Alkali Inspectorate. His Council considered that none of the processes, other than the manufacture of blue bricks, which took place in the area should be scheduled. Mr. Thomas drew attention to the Report of the Joint Standing Committee on Safety, Health and Welfare Conditions in Non-Ferrous Foundries (just published) and the paragraphs in it dealing with dust and fume disposal and open fires, and said: "In that report there is no mention of any special technical difficulties . . . we think that the same thing applies not only to non-ferrous foundries but also to ferrous foundries."

In his closing statement Mr. Marshall submitted that any reference to the report of the Joint Standing Committee on Conditions in Non-Ferrous Foundries was irrelevant as the work of that Committee and the report standing in its name related to the air inside the foundry and had no relation to external air pollution.

Representations were made by the Willenhall Urban District Council supported by the West Midlands Urban District Councils Association supporting the view that transfer to the Alkali Act of metallurgical works should be strictly limited to the few works where special technical difficulties existed.

In bringing the public hearing to an end, Sir Frederick Armer thanked the representatives of the organizations and their witnesses for the very full and clear way they had put the problems to him and to Mr. Damon, the Technical Assessor. He proposed, with Mr. Damon, to visit some of the industrial processes, and after that he had to make his report to the Minister of Housing.

(Immediately after the close of the inquiry Sir Frederick and Mr. Damon arranged a series of visits to iron foundries in the Birmingham area; the works visited included those of Dartmouth Auto Castings, Limited, Smethwick; Castings, Limited, Walsall and Brownhills; Chamberlin & Hill, Limited, Walsall and Lichfield; Bradley & Foster, Limited, Darlaston; Thomas Perry, Limited, Bilston, and Hopyard Foundries, Limited, Bilston.)

Improving the Mechanical Properties of Cast Steel

(*Continued from page* 10)

The primary requirements for improving the properties of steel castings can be summarized as follow:—

(*a*) Progressive introduction of alloying combinations for steel castings together with control of heat-treamtent.

(*b*) The development of new varieties of alloy-steel castings with better mechanical properties and possessing good casting features.

(*c*) The wider application of metal moulds and chills.

(*d*) The use of existing processes and the development of new foundry procedures to lead to adequate feeding of castings (increased taper, location of feeder heads, and pressure feeding).

(*e*) Improvement in the techniques of steel melting and the development of procedures for the modification of structural steels.

Developments at the Croydon Works of Federated Foundries

New Plant for Spinning Soil-pipes

The design of builders' and domestic castings has changed little in the past 20 years, it is of major interest, therefore, that Federated Foundries, in their Southern Foundries at Croydon, have commenced production of a new type of soil-pipe. The following article is an illustrated description of the plant and processes involved. It covers the production of "eared" pipes, Fig. A, by the spinning method, at the rate of about 120 castings per hour.

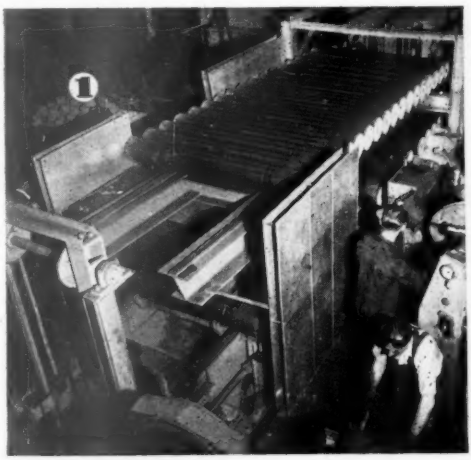
Federated Foundries, Limited, in their Southern Foundries branch works at Purley Way, Croydon, have just completed a plant for spinning soil-pipes (conforming to B.S. 416). The machine used is shown in Fig. 1, from which it will be seen that there are about 30 dies, which are automatically fed to the pouring position. Before filling and spinning, the moulds are sprayed with a mixture of Kieselguhr and bentonite, at the end remote from the pouring position. Additional provision is made for an extra coating at the inlet end, where heat checking is likely to be most severe. A "Dustmaster" plant is installed at the pouring side to ensure that none of the powder enters the shop. At the exit end of each die, a core is inserted which forms the ear; this requires a handle to be manually turned for securing it in position. In Fig. 2 is shown the automatic extractor in operation; the end of the bar enters the still hot pipe, expands, grips and extracts the pipe from the die. Should this method fail, the pipes are easily extracted by hand, using a similar tool. When it reaches the lowest position, shown in Fig. 2, the pipe is vibrated to facilitate release; the pipes are then automatically transferred from the shop to the cooling tunnel shown in Fig. 3, where they are allowed to cool naturally.

FIG. *A.—Close-up view of the new patented "eared" spun pipe, showing the contour of the socket.*

Coremaking

The coreshop is a separate department adjoining the main shop, and is operated entirely by one female operator. Sand, stored in an overhead hopper is mixed with a resin binder in a Fordath mixer. Cores are made on a six-unit Jackman-

FIGS. 1 *and* 2.—*Two views of Federated Foundries soil-pipe spinning machine. Fig.* 1—*Magazine, delivering dies (about* 30 *are in use) automatically to the pouring position. Fig.* 2—*Extractor mechanism to facilitate the withdrawal of hot pipes from the dies, after casting.*



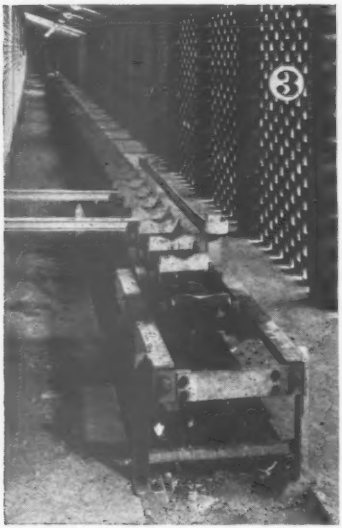


FIG. 3.—*After withdrawal, pipes pass through a long cooling tunnel with honeycombed walls.*

FIG. 4.—*General view of the pipe-spinning machine at the Croydon works of Federated Foundries, Limited; trolleys employed for core transit can be seen on the right.*

Osborn coreblower machine, and are placed, using a special board, on to a slowly-moving conveyor, which passes into a Metalectric deep-ray furnace, where on emerging, they are loaded on a wheeled trolley fabricated from Meccano-like perforated strip, for transfer to the foundry. These trolleys can be seen to the right of Fig. 4, which provides a good overall view of the complete machine.

Metal Preparation

It has been found, for this spinning plant, that a casting temperature of 1,300 deg. C. gives the best results; the metal has to be of fairly high carbon and above all, of constant composition. Metal from the cupola melting-plant is stored in an oil-fired Monometer receiver (Fig. 5), teemed into drum-type ladles, suspended from overhead-cranes. This feeds the small 50-lb. capacity ladle (shown in Fig. 1), filling being carried out every half minute, permitting the production of 120 pipes per hour.

The cooled pipes are automatically transferred to the dressing shop (Fig. 6), where a reaming machine thoroughly cleans the inside bore, and are

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FIG. 5.—*Oil-fired Monometer receiver, which teems into 50-lb. capacity ladles.*

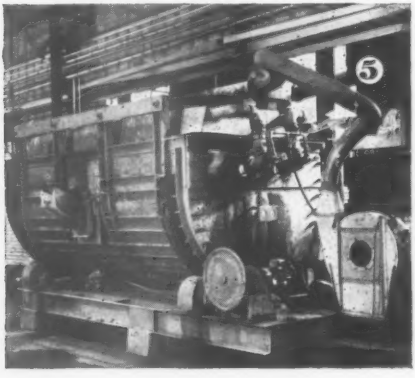
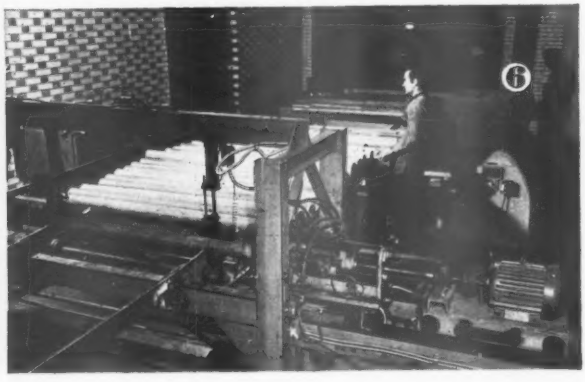


FIG. 6.—*View of the dressing shop, showing the automatic reaming machine in operation.*



Properties of Cast Iron at Elevated Temperatures

*A Progress Report . . . . . By J. R. Kattus**

A research programme, to investigate the properties of cast iron at elevated temperatures, which has been in progress since 1954 at the Southern Research Institute, was sponsored by the joint committee of the American Society of Mechanical Engineers and American Society for Testing Materials. This joint committee was formed to examine the effects of temperature on the properties of metals. The objective of this work is to determine the suitability of cast-iron alloys for load-carrying applications, whilst subjected to a temperature in the range of 370 to 535 deg. C.

The following phases of the research programme have been completed: (1) A survey of literature on related work in the field to be examined; (2) screening tests on twelve commercial cast-iron alloys; (3) creep-resistance tests at temperatures from 425 to 535 deg. C. on seven of the most promising alloys, for periods of time up to 5,000 hours, and (4) thermal-shock tests on the same seven alloys.

Resulting from the survey of literature and screening tests, the seven alloys selected for phases 3 and 4 of the programme were:—pearlitic grey iron alloyed with molybdenum; pearlitic grey iron with nickel/molybdenum; 50:50 pearlitic:ferritic grey iron alloyed with chromium (annealed for four hours at 900 deg. C.); ferritic nodular iron; pearlitic grey iron alloyed with chromium/nickel/molybdenum; unalloyed pearlitic grey iron, and chromium/molybdenum alloyed pearlitic grey iron.

The creep-resistance properties of the cast-iron alloys that were tested, for applications requiring the support of considerable loads at temperatures in the region of 535 deg. C. are not promising. Alloys with high short-time creep resistance properties, at this temperature, underwent a sharp decrease in properties, when tested for times in the order of 100 to 500 hours, other alloys possessed uniformly low creep properties. The test results indicate that cast-iron alloys are suitable for load-carrying applications at 425 deg. C.; at this temperature, no sharp deterioration in creep properties occurred with exposure times approaching 5,000 hours.

Effect of Alloying

Alloying has a marked effect on the creep-resistance properties of cast iron; among the alloying elements tested, molybdenum is the most potent for improving these properties. The chromium/molybdenum iron had the best properties of all the alloys tested, but chromium additions alone were not beneficial to creep-resistance properties. The chromium/molybdenum iron had creep properties intermediate to those of a hot-rolled carbon/molybdenum steel and hot-rolled low-carbon steel. All the other irons were inferior to the low-carbon steel, although the creep-resistance properties of chromium / nickel / molybdenum / vanadium iron, closely approached it. The unalloyed ferritic nodular iron was slightly superior to the unalloyed pearlitic grey iron.

No consistent correlations have been detected between the creep properties of cast iron and metallographic structure or heat-treatment. Wide variations in properties were obtained on pearlitic grey irons with similar matrix and graphite structures. In tests at 535 deg. C. on "as-cast" irons, partial spheroidization of the carbide occurred after about 100 hours' exposure. This structural change coincided with sharp deterioration in creep-resistance properties. The structures of the annealed chromium-alloyed iron and ferritic nodular iron did not change during tests at 535 deg. C., and no sharp deterioration in their properties was found (uniformly-low). However, the creep properties of annealed samples of the chromium/molybdenum grey iron, which was relatively strong, underwent a sharp deterioration after about 100 hours at 535 deg. C., although no structural changes could be detected at the conclusion of tests. In tests up to 5,000 hours duration at 425 deg. C., no structural changes were detected in any of the test alloys.

Thermal Shock

The suitability of cast iron for many applications depends upon its ability to withstand thermal shock; past experience indicates that the most reliable thermal-shock test data are obtained under conditions, similar to those encountered in a particular type of service, and are used only in conjunction with that type of application. Nevertheless, an effort was made to determine the characteristics of cast iron under severe thermal-shock conditions. Since the creep-resistance tests indicated that cast-iron alloys are not promising for service at 535 deg. C., thermal-shock testing was carried out at only 425 deg. C.

After preliminary investigations of a number of possible thermal-shock tests, a technique was adopted in which the test-specimen was thermally cycled, while it was subjected to specified external bending load. The tube-like specimen formed the centre section of a simple beam, that was dead-weight loaded equally at both ends and supported at two points on opposite sides of the specimen. In carrying out a test, the specimen was loaded and thermally cycled between 425 and 65 deg. C., the number of cycles to rupture being noted. The heating time in each thermal cycle was 85 sec.; cooling was accomplished in 15 sec. by pouring water over the specimens—both smooth and notched specimens were tested. The notched test

* The Author is head of the metallurgy section, Southern Research Institute, USA.

Cast Iron at Elevated Temperatures

was adopted as standard, since it was more severe and applicable to all alloys. The smooth nodular-iron specimens failed to rupture whilst subjected to thermal shock.

Each alloy was tested at a number of stress levels, and the data were plotted in the form of thermal-fatigue curves showing stress *versus* number of cycles to failure. A thermal-fatigue endurance limit was invariably approached within 100 cycles on the thermal-fatigue curves. Below the stress level, corresponding to this number of cycles, thermal-shock failures are not likely to occur under the conditions of the test, regardless of the number of cycles.

In Table I, the 10-year rupture strength and thermal-fatigue endurance limit for various alloys

TABLE I.—*Comparison Between 10 Year and Thermal Fatigue Endurance Limits.*

Alloy.	10-Year rupture strength at 425 deg. C., tons per sq. in.	Thermal-fatigue limit, in tension at 425 deg. C., tons per sq. in.
Chromium/molybdenum grey iron	13.4	7.8
Molybdenum grey iron	11.2	6.7
Chromium/nickel/molybdenum/vanadium grey iron	11.2	7.2
Unalloyed ferritic nodular iron..	7.6	12.3
Unalloyed grey iron	6.7	5.6
Nickel/molybdenum grey iron ..	11.2	8.0
Chromium grey iron	—	5.6

* The 10-year rupture strength is based upon an extrapolation of test data and also upon an approximation afforded by the Larson-Miller parameters.

at 425 deg. C. are compared. The stresses shown in this table are recommended, as the maximum applied tensile stresses for the various alloys, in applications involving creep or thermal shock. It should be remembered that the thermal-fatigue endurance limits are not absolute values, but are dependent upon the conditions of the test. The values given, apply to repeated severe applications of thermal shock, equivalent to that produced in tests on notched specimens. Maximum stresses for service applications involving both creep and thermal shock should be based upon the 10-year rupture strength, or thermal-fatigue endurance limit—whichever is lower.

The unalloyed ferritic nodular iron was found to be far superior, in thermal-shock resistance, to any of the grey irons that were tested. Small additions of molybdenum and nickel improved the thermal-shock resistance of grey iron.

AN ORDER for the construction of a single-deck motor cargo vessel of about 6,500 tons d.w. has been awarded to Hall, Russell & Company, Limited, Aberdeen, by the Burnett Steamship Company, Limited, Newcastle-upon-Tyne. The main propelling machinery will consist of a Clark-Sulzer engine.

THE INCLUSION OF G. & J. Weir, Limited, among works to be visited during the centenary celebrations of the Institution of Engineers and Shipbuilders in Scotland, is a reminder of the long association existing between the two. More than 60 years ago, Lord Weir joined the Institution as a Graduate, and he has been an honorary member since 1921.

Developments at the Croydon Works of Federated Foundries

(*Continued from page* 14)

automatically weighed, as the specification calls for both maximum and minimum tolerances. Then a water test is applied, which subjects the pipes to a pressure much in excess of the specified figure of 6-lb. per sq. in. To facilitate fixing, to a wall, or structure, a hole is drilled in the ear and, using the flange as a support, the pipes are put in forks, suspended from an overhead conveyor which carries them through a wet-coating plant.

Most of the plant has been engineered by the staff of Federated Foundries, and good use has been made of the latest mechanical-handling equipment, whilst a meticulous metallurgical control has been imposed. The firm attach much importance to the introduction of the ear on the pipe, for it is hidden when the pipes are erected and presents a neater looking job; moreover, stacking is simplified.

Refractories Association's Meeting

Mr. W. T. Price, the retiring president, occupied the chair during the formal business of the annual general meeting of the Refractories Association of Great Britain, held at Sheffield last month, and until the new president, Mr. Arnold Carr, was installed.

Referring to the past year's activities, Mr. Price emphasized the success of the association's social events. He thanked the officers and members for their support and paid tribute to the work of Prof. James White, who organized the successful lecture course. Mr. S. B. Turner has replaced Mr. Arnold Carr as a vice-president of the association, while Mr. Turner's place on the Council has been filled by Mr. J. F. Trevor.

Brussels Exhibition

The British section at the Universal and International Exhibition to be held at Brussels from April 17 to October 19, 1958, will occupy five acres and will contain two pavilions. The Government pavilion will be organized by the Central Office of Information. The industrial pavilion, to be organized by the Federation of British Industries through its subsidiary, British Overseas Fairs, Limited, will be for the display of British products by trade sections. Among the industries to be prominently represented will be iron and steel, electrical engineering, tele-communications, chemicals, engineering, and the peaceful uses of atomic energy.

A limited amount of exhibition space is still available; firms or associations are invited to get in touch immediately with British Overseas Fairs, Limited, 21, Tothill Street, London, S.W.1 (telephone: WHItehall 6711).

THE MOST COSTLY item on the Union of South Africa's import list are the metals and metal-manufacturers group. Reporting this, Barclays Bank DCO, which has more than 600 branches in South Africa, reports that in 1956 the group accounted for nearly 37 per cent of the total value of all goods imported—the Union's import bill for 1956 amounted to £494,800,000.

Structure Variation of Ingot Moulds in Use*

Results of French Investigations on Repeated Thermal Shock

Ingot moulds are subjected to continual thermal shock, during their service life, taking the form of extremely rapid heating and relatively slow cooling cycles. These thermal changes are likely to produce changes in the microstructure of the mould material; the Paper outlines the results of a series of experiments that have recently been carried out in France, and concludes with details of the two types of variation of structure that are usually found.

To study the structural changes which occur in ingot moulds, tests were made on moulds from a number of different works, the majority being in the 4 to 5-ton capacity range, but additional information is available, on moulds of up to 15-ton capacity. The work was based on a detailed structural examination of 20 new and ten used moulds; of the latter, seven were examined before and after service, thus enabling a direct examination to be made of the changes caused by repeated heating and cooling cycles.

New Ingot Moulds

When the moulds were first examined, in their rough-cast state, it was found that they could conveniently be divided into two classes:—

(*i*) Seventy per cent. were completely pearlitic throughout their thickness, with ferrite occurring only in the immediate neighbourhood of the inside and outside faces of the mould.

(*ii*) The remainder contained a proportion of ferrite in the mid-thickness region of the mould, ranging from a few rare crystals in grain boundaries or in graphite laminas up to a concentration of 50 per cent. ferrite.

A general observation may be made, therefore, that in the majority of cases the proportion of ferrite diminishes continuously from the surface of the mould towards the centre, and remains practically constant across the thickness, except near the faces. Examination of the chemical composition of the moulds from various foundries showed that the ferrite distribution was little affected by changes in composition; it was noticed, however, that moulds containing a higher proportion of ferrite at mid-thickness generally have a slightly lower manganese content. This point may be worth further examination. Specimens taken from various positions (*i.e.*, different levels) of the same mould showed little variation of structure.

Variation with Thickness

A convenient method of representing the ferrite distribution in the mould is to plot the thickness of the mould horizontally, and use as ordinate the corresponding percentage of ferrite at that position. The results from moulds tested, enable a division to be made into the two sections mentioned in the previous paragraph, with two further sub-sections.

The variations in structure are shown in Fig. 1, from which it is clear that the two main divisions are:—Type A, where the amount of ferrite diminishes continuously as one moves away from the faces, and Type B, where the amount of ferrite increases at mid-thickness.

In Type A there is a large proportion of ferrite at the inside and outside faces, ranging between 20 and 90 per cent.; the structure changes rapidly over the first few centimetres of the thickness to either a purely pearlitic structure (Type A_1) or a structure containing traces of ferrite (Type A_2). The majority of moulds are of Type A_1, and in both cases, the structure remains the same across the middle region of the mould.

Type B may also be divided into subsections. The proportion of ferrite at the surface is higher (50 to 100 per cent.), but there is a more marked variation of ferrite with thickness, and there may be a band of complete disappearance of ferrite. Towards the centre of the mould, however, ferrite reappears in greater quantities, and the mould may be subdivided into Type B_1, where the ferrite at mid-thickness is comparatively small, and Type B_2 where the proportion is high.

The distribution of ferrite is not always symmetrical, however, judging by the small number of tests carried out, the lack of symmetry is not always in the same direction. The only general conclusion, which can be made, is that if the amount of ferrite is important on one face it is also important on the other, and that, in any given mould, the proportion of ferrite is approximately the same on each face.

Little information is available on the size of the graphite laminas, except that they vary in size as one moves away from the face of the mould. At mid-thickness, an average size is 0.5 to 0.6 mm., but near the faces this is reduced to less than 0.1 mm. The distribution of the graphite laminas is not symmetrical, since there is a concentration towards the inside face, confirming that the inside face chills more rapidly than the outside. The laminas of graphite of less than 0.1 mm. thickness are found only in a small number of moulds, generally in assocation with large quantities of ferrite at mid-thickness.

Previous work by Vaille[1] should be mentioned in this connection. His work shows a complete absence of graphite on the fraction of a millimetre which constitutes the internal or external face of the mould, but this surface layer is followed by a thin zone (approx. 0.15 mm. thickness) of ferrite, and then a zone (0.15 mm. to 0.25 mm.) of

* Abstracted from a paper by M. Ferry, published recently in *Fonderie*.

pearlite, followed by a general mixture of pearlite and ferrite.

Summarizing the above, it appears that there is no satisfactory reliance to be placed on the structure at mid-thickness, and that there is insufficient evidence at present to relate the structures at the surface, 10 mm. depth and at mid-thickness.

Used Ingot Moulds

Several tests were carried out on moulds due for scrapping, and as already mentioned, in seven cases a direct comparison could be made with their structure in the rough cast state. This enabled the effect of their service on the structure to be evaluated, to supplement previous investigations[2, 3, 4, 5]. The main points which are of importance are:—(*i*) The progressive oxidation of the surface of the metal at the inside face, and (*ii*) the formation of ferrite and the coalescence of pearlite carbides in the regions heated to near the transformation point.

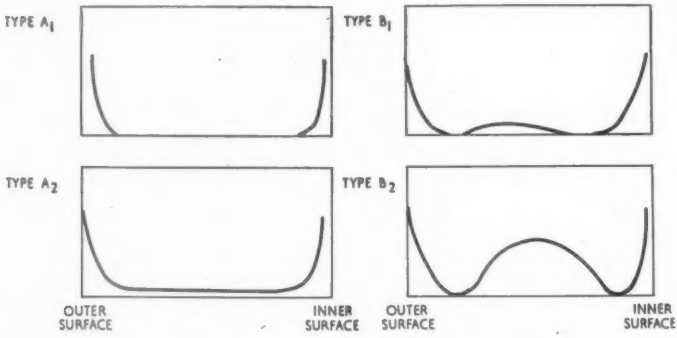


FIG. 1.—*Four types of variation of ferrite content through the cross-section of ingot mould walls.*

If the original structure of the mould was pearlitic, with ferrite only on the inner and the outer boundaries, it is easy to see which parts of the mould have been affected. The last traces of ferrite and of coalesced carbides disappear at a maximum distance of 20 to 25 mm. from the inside face, and in many cases this distance is only a few millimetres. Thus only a small thickness is affected by service conditions, and no modification of the structure occurs at mid-thickness or at the outer surface. After use, the inside surface appears as a network of cracks, up to 1 cm. deep, and, in the process of sampling, this layer of cracks often becomes detached, leaving a metal with relatively little oxidation.

Again, the moulds examined may be divided into two main groups, depending upon the proportion of ferrite at the surface. With a relatively small proportion of ferrite at the surface with the remainder of the structure at mid-thickness completely pearlitic, the structure is only affected within a few mm. of the surface below the oxidized crust, and the major part of the structure is still completely pearlitic. In the second group, with a higher proportion of surface ferrite, after the heavily oxidized crust there is a completely ferritic band of the order of 10 mm. thickness, followed by a further band of 10 mm. thickness in which the ferrite slowly disappears. A penetration depth of some 20 to 30 mm. is therefore necessary before an unchanged structure is reached.

Conclusions

The above data show the two distinct types of variation of structure with thickness:—

Type A, with ferrite only at the surfaces of the mould, decreasing continuously as one moves away from the surfaces to an almost completely pearlitic structure at mid-thickness, with only traces of graphite after a depth of 20 to 30 mm.

Type B, with larger amounts of ferrite at the surfaces and a certain amount of ferrite at mid-thickness. Such moulds have a tendency to graphitization, and the oxidation process affects a wider zone than in the previous type of mould.

Formation of ferrite is generally associated with slow rates of cooling, and it is therefore not surprising to find ferrite at the heart of the mould. The ferrite zones at the inner and outer surfaces are more difficult to explain, but it appears that a double action takes place. On the one hand, the metal is oxidized by the layer of air which forms between the metal and the mould during solidification, the existence of this decarburization being shown by the vanishing, in certain cases, of the graphite. On the other hand, the graphite is finely disseminated at the surfaces and the diffusion of austenitic carbon is more rapid.

The problems presented by this survey indicate that further work is necessary, and that an examination of a much larger number of moulds is required before a complete explanation and account of the structural changes can be given.

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Law Cases

Moulder Burnt

A 40-year-old West Bromwich moulder Mr. J. T. Newall, whose left foot was burned by molten metal, splashing from a ladle, claimed damages of £200 for personal injury from Highway Ironfounders, (West Bromwich), Limited, at the West Bromwich County Court on Wednesday, June 18.

Mr. H. J. Garrard, for the plaintiff, claimed that after a period of redundancy, Newall returned to work, but was not given the customary protective spats, which he had worn previously. He did not ask for any because he thought he was protected by a pair of new double-tongued industrial boots, which he had bought. The accident occurred a short time after his return to work and, Mr. Garrard contended, that had he been wearing spats, his foot would not have been injured by the metal. Mr. Garrard added that when Newall returned to work, five weeks after the accident, he was told by the foreman that he must wear spats. Addressing Judge R. H. Norris, Mr. Garrard submitted that plaintiff was allowed to rest in a false sense of security, thinking the boots were adequate protection.

For the defendants, Mr. E. G. H. Beresford said that there was no provision in the regulations relating to the use of spats for the job carried out by the plaintiff.

The defendants provided spats and the plaintiff admits that before he became redundant he signed for these in December, 1954. He did not return them, when he became redundant.

When he recommenced work, there was no means of the employers knowing that he had discarded the spats. It was not the duty of the employers to inspect his boots, to see whether they offered adequate protection; in addition he admits that he should have worn spats and having instilled this thought into his mind, what more could the employers have done. "I submit that the responsibility for this, not very serious accident, must rest upon the plaintiff," he declared.

Judge Norris said the case needed consideration, and adjourned to a date to be fixed.

Firm Wins Eye-injury Case

Judge A. M. Hamilton made a practical test of a pair of industrial goggles at Warwick County Court on Friday, June 14th, after he had heard complaints that they misted up in a minute or so.

John William Richards, tool setter, had claimed damages against the Lockhead Hydraulic Brake Company, Limited, of Leamington, as a result of an injury to his eye, when a piece of metal flew into it during a grinding operation at the factory in October 1955. He said he was issued with goggles, but found they were useless as they misted up within a minute or so. Complaints were ignored. He had suffered no permanent injury to his eye, but was away from work for 16 days.

Arthur Hunt, superintendent of Richard's section, denied that complaints were made. The firm was continually impressing on the men the need to wear goggles and regular checks were made to see that the goggles were in a satisfactory condition.

In dismissing the claim, and awarding costs to the defendants, Judge Hamilton said: "I am abundantly satisfied that it is ridiculous to suggest that the goggles mist up in a minute or so. While I make every allowance for the difference between the conditions in this court and those at the factory, I cannot overlook the fact that I have been wearing these goggles for 17 minutes 45 seconds without experiencing any diminution of visibility. The firm has done all it possibly could to supply goggles and see that they were worn. On the other hand the plaintiff was in breach of his statutory duty to wear the goggles and guilty of contributory negligence which solely caused this accident."

Appeal Rejected

The Villiers Engineering Company, Limited, Wolverhampton appealed unsuccessfully in the Court of Appeal on June 19 against an award at Stafford Assizes of £402 15s. damages for personal injuries to Mr. Joseph White, a moulder of Low Hill, Wolverhampton. The appeal was dismissed with costs. Mr. White was employed by the company and was burned on the left foot by molten metal. Mr. Justice Byrne, at the Stafford Assizes, assessed the total damages at £537, but reduced the amount, holding Mr. White to be one quarter to blame. The company appealed on the ground that the Judge was wrong in finding it negligent, and alternatively contended that his lordship had apportioned too much of the blame to the company.

Giving judgment, the Master of the Rolls, Lord Evershed said he felt some sympathy with the company; on the evidence it could not be called a careless or thoughtless employer. In fact it seemed to have quite the opposite reputation, judging by the length of service of employees. The Judge, however, was entitled to come to the conclusion he did—that the presence of moulding boxes, not in use, caused an obstruction to men carrying molten metal and constituted negligence by the employers. He could see no reason to quarrel with the apportionment of blame. Lords Justices Morris and Pearce agreed.

Burned by Sulphuric Acid

Because of a disfiguring scar on her elbow and forearm, caused by sulphuric-acid burns, Miss Winifred Irene Williams (23) was stated at Chester Assizes to be prevented from baring her arms. Mr. Justice Oliver awarded her £370 damages in her action against her former employers, Sykes & Harrison, Limited, iron and non-ferrous founders, of Port Penrhyn, Bangor (north Wales).

It was stated that Miss Williams was carrying out tests to ascertain the carbon contents of metal. While resting her elbow on a slate slab, to enter readings in her notebook, she felt a burning sensation on her arm. Mr. Justice Oliver said that had the scar been on her face Miss Williams would have been ruined, but even so, being young and athletic, she had been deprived of a substantial enjoyment of life. He found that the sulphuric acid escaped from an apparatus, through a valve, which the firm knew to be defective.

Tongsman's Leg Crushed

Damages of £1,000 were awarded by a jury sitting with Lord Migdale, in the Glasgow Court of Session, to Mr. Daniel Cunningham, tongsman, Coatbridge, whose left leg was crushed in an accident in the cogging mill of Bairds & Scottish Steel, Limited, Coatbridge (Lanarkshire), on January 28, 1955.

Mr. Cunningham, who sued the company for £2,500, was assisting in passing a 60 ft. ingot, weighing more than 2 tons, through the mill, when a large box of scrap metal was knocked over, injuring his leg.

The defendant company denied blame for the accident, maintaining that all reasonable care for the safety of employees was taken. The plaintiff was blamed for the accident.

Notes from the Branches

South Africa

"Foundry Mechanization" was the subject of a lecture presented by Mr. H. A. Godwin to the South African branch of the Institute of British Foundrymen, on May 23, in Johannesburg; Mr. S. Pienaar, senior vice-president, was in the chair.

Mr. Godwin's paper dealt primarily with the types of mechanization best suited to South African conditions and particularly to the foundry, varying from jobbing to medium productions of castings. In South Africa the relatively small runs of castings, coupled with a labour condition not usually experienced elsewhere, added their own particular problems to those already existing, in the consideration of the extent of mechanization. "Mechanization," said Mr. Godwin, "has long been a subject which has taxed the imagination of man. It has held out a promise of prosperity and comfort for a minimum of energy expended. As the ingenuity of man has increased so the rewards of mechanization have increased, until, to-day, it is apparent that the machine has altered the whole course of our lives. Just as the machine is the cornerstone of our modern way of life, so in the scheme of things is the foundry the birthplace of the machine. Ironically, mechanization of the foundry is a recent innovation."

Mr. Godwin suggested that the use of scale-down templates would be of great help when designing a foundry lay-out. Of even greater assistance would be the use of scale models* of the type of machines, conveyors, etc., envisaged in the final layout, for these give one a clear picture of the "above ground" space, a most important point when the foundry to be mechanized was in an existing building. The Author also stated that although it might seem reasonable to mechanize from the beginning of the process and work towards the end it was safer to mechanize the last operation first, then work toward the front. In this way, bottlenecks, which render inefficient any mechanized system, would be eliminated.

After illustrating and discussing various types of moulding machines, Mr. Godwin pointed out that in order to produce 1 ton of castings between 100 and 250 tons of material and equipment had to be handled, depending on the type of foundry. It was equally true that the major handling problem occurred between the making of the mould and the knockout of the casting and return of the box and sand to the moulding station. In the field of mould conveying, the engineer had indeed been at his inventive best, with the result that the foundryman had a wide range from which to choose the conveyor that would best suit his particular needs.

Mr. Godwin's paper also included details of knockout grids, moulding boxes, and other sundry equipment. In conclusion he warned of the danger of overmechanization; nowhere, he said, was there greater danger than in South Africa, as in the main, the run of castings available to local foundries does not justify a highly-mechanical plant, but rather one of great flexibility.

An interesting discussion was concluded by Mr. W. Allan as follows: "All foundrymen appreciate the need for mechanization in the foundry, but the heavy nature of the work involved in this industry calls for thought in this connection. Mr. Godwin's views on mechanization have been extremely comprehensive and the points put forward have been generally accepted." On behalf of the branch, he proposed a vote of thanks to Mr. Godwin for presenting such an interesting paper.

* See "Trial Foundry Layout Simplified." FOUNDRY TRADE JOURNAL, December 6, 1956.

Australia (Victoria)

The May meeting of the Australian branch took the form of a round-table conference. The subject of "Iron" was introduced by Mr. K. H. Andrews, chief metallurgist, General Motors-Holdens; that of "Aluminium" by Mr. J. Pearce, assistant foundry superintendent, Russell Manufacturing Company, Limited, whilst the "Copper-base Alloys" were dealt with by Mr. J. H. Roberts, metallurgist, John McIlwraith Industries. During the month the members of the branch participated in a meeting organized by the Australian Institute of Metals, when Mr. David Bryant gave a lecture on "Oxygen in the Iron and Steel Industry."

Book Review

Cast Metals Handbook (4th Edition). Published by the American Foundrymen's Society, Des Plaines, Illinois. Obtainable from the Penton Publishing Company, Limited, 2, Caxton Street, London, S.W.1; price 80s., post free.

This well-known book has now reached, as it well deserves, its fourth edition. During the last three years, it has been thoroughly revised and the newer specifications have been incorporated. The coverage is alike wide and complete and practically all foundry alloys are dealt with. Whilst a third of the book is devoted to the various types of cast iron, the other sections, steel and non-ferrous alloys, have received adequate treatment. Patternmaking has a chapter to itself and an official specification has been included. It is interesting to note that for 100- to 200-off patterns, the text states that the following should also be supplied:—(*a*) Rubbing fixtures for cores; (*b*) coresetting and pasting jigs; (*c*) drier (shell-carrier) patterns and driers (shell carriers); (*d*) fillets carved in wood and (*e*) four applications of a high-grade pattern coating. Though there is no mention of epoxy-type resin for patterns, the information printed serves very well as a specification. The contents of this book are so well known that detailing them is quite superfluous. As a work of reference for both engineers and foundrymen, it is invaluable.

Publication Received

Training for a Career at K. & L. Issued by K. & L. Steelfounders, Limited, Letchworth, Herts.

Whilst this is a delightfully-produced brochure, the reviewer does not believe the best has been achieved. Regarded alike from either the parents' or the boys' points of views, too much knowledge of industrial techniques is taken for granted. For instance, one learns that instruction for a foundry apprentice includes "Feeding and running techniques and the application of chills and chaplets." All these words have quite another significance for the baker or grocer and indeed could be gibberish to many laymen, to whom presumably the booklet is addressed. Maybe the compiler was placing some reliance on the "snob" appeal which is so successful in commercial advertising. Despite this criticism, it must be confessed that this brochure is as good as any so far seen by the reviewer, with one exception. This one, with exceptional appeal, was addressed to youth and painted for him verbal pictures of his arrival at the works, his training and jobs. For the parents, the best part of the K. & L. booklet is the last two pages covering the general facilities available; this is particularly well done.

Company News

WALLIS TIN STAMPING COMPANY, LIMITED—Bovril, Limited, has exercized its option to take up 175,000 2s. ordinary shares in the company at 4s. 6d. per share.

HELICAL BAR & ENGINEERING COMPANY, LIMITED—Seton Trust is to make available as a placing a block of the ordinary shares of the company. Issued capital is £118,924 10s. in ordinary 5s. shares.

BRITISH STEEL PILING COMPANY (HOLDINGS), LIMITED—The company is maintaining its 10 per cent. dividend for 1956, with an unchanged 6 per cent. final, but is not repeating the 5 per cent. bonus. Group profits were below the 1955 level, the net balance being £70,969 (£100,536) after tax.

GEO. W. KING, LIMITED, mechanical handling engineers, etc., of Stevenage (Herts)—Treasury consent has been given to a 50 per cent. scrip issue in "A" non-voting ordinary shares. It is also proposed to increase the authorized capital to £750,000. Net profits have risen to £77,614 (£63,820) and the dividend remains unchanged at 12½ per cent.

ALLEN WEST & COMPANY, LIMITED—The proposed three-for-10 scrip issue will be made to ordinary stockholders registered on July 1. The new shares will not participate in any dividend for the year ended January 31, 1957, and a warning is given that the issue "does not imply any increase in the total sum proposed for distribution in any one year."

FARROW & JACKSON & PURDY, LIMITED, London, E.1, the holding company of Farrow & Jackson, Limited, brewer's engineers, of London, E.1, and the Purdy Machinery Company, Limited, labelling machinery manufacturers, of London, N.W.1—Although the interim was passed, the company is maintaining its dividend at 7½ per cent. for 1956. Group net profit after tax is £16,665 (£16,566).

NEWALL ENGINEERING COMPANY, LIMITED—Based on substantial order-books the company is looking forward to a period of steady expansion to meet an ever-increasing market for more precise and automatic machine tools. Group net profits improved from £99,674 to £100,286 in the year ended March 31 last. The dividend is repeated at 15 per cent., but this time there is a capital distribution of 5 per cent., tax free, out of capital profits.

GAS PURIFICATION & CHEMICAL COMPANY, LIMITED—CIC consent has been given to the formation of a new company, Amphenol (Great Britain), Limited, with a fully paid share capital of £100,000, half of which will be subscribed from its own cash resources and half by the Amphenol Electronics Corporation, of Glasgow. The new company, acting under licence from the US company, will offer the entire Amphenol range of electrical connectors, etc.

PATERSON ENGINEERING COMPANY, LIMITED—The offer of Portal, Limited, of 21s. cash for the preference shares of the company, ex June 30 dividend, is conditional upon a 90 per cent. acceptance on or before July 26, and the offer for the ordinary of 18s. cash and eight 5s. ordinary Portal's shares ranking from January 1, 1957, is conditional upon acceptance by 75 per cent. in number of shareholders holding between them 90 per cent. of the outstanding ordinary capital, not later than July 26, percentage and date at Portal's option.

DANIEL DONCASTER & SONS, LIMITED, steelmakers and stockists, of Sheffield—Indications are that for some months the company will be fully occupied in nearly all sections, though in some departments the volume of work ahead is not so great as a year ago. In the year ended March 31 last, trading profits expanded by 28 per cent. to £777,954. Sales value rose considerably, mainly due to the increased volume from new plant and only partly through higher selling prices. The equivalent 15 per cent. dividend on the present capital represents a 2½ per cent. increase over 1955-56.

FRANCIS MORTON & COMPANY, LIMITED, bridge and constructional engineers, of Liverpool—Trading profits were more than halved in the year ended March 31, 1957, but the final dividend of 9¾ per cent., making 16¾ per cent., is equivalent to the 20 per cent. paid prior to the one-for-five scrip issue. Net profit is £16,468 (£58,218). Increased costs and reduced margins are not wholly responsible for the reduced profit. The company is concerned in large contracts extending over two or three years and in 1956-57, which was an abnormal year, more than half total production was for contracts not completed.

VERITYS, LIMITED—Mr. P. J. H. Coates, who has been appointed a director and general manager, has made a preliminary examination of the company's position in regard to its products, methods of production, and marketing arrangements, says the chairman, Mr. R. M. Mair. Mr. Coates is satisfied that there will be a large increase in the requirements for the company's products as it is a rapidly expanding market, but in order to obtain this increase, the company must first redesign a number of its products which have become cumbersome when compared with the modern products of a streamlined factory. He is certain that at the moment many sales opportunities are being missed.

German Expansion Plans

Large-scale expansion and modernization plans to cost £65,000,000 over the next three years, are announced by two German steelmakers, Mannesmann Huttenwerke A.G. and the Krupp-owned Huttenwerk Rheinhausen A.G. Mannesmann is to raise annual output by 500,000 tons to 2,500,000 tons and output of tubes from an estimated 800,000 tons this year to 1,200,000 tons by 1960. The Rheinhausen programme, which is to be completed by 1960, aims to increase annual steel output by 600,000 tons to 2,500,000 tons.

The capital investment programme of Mannesmann will cost about £40,000,000, to be spent partly on two blast furnaces, two open-hearth furnaces, a plate mill, coking installations, a semi-continuous wide strip mill (jointly with Hoesch) and the expansion of capacity in tube-making plants in Canada and Brazil. The Rheinhausen programme includes one 120-ton electric furnace, one 180-ton open-hearth furnace and four basic Bessemer converters of 45 tons each, together with the modernization of all nine blast furnaces.

Reorganization of Thyssen interests in the Ruhr was taken a step further with the recent resignation of Herr Görgen, chairman of the board of Phönix-Rheinrohr steelmakers. With Herr Görgen's withdrawal, Herr Gunther Sohl, chairman of the board of the Thyssen steelworks, the Association of the German steel industry, and of the supervisory board of the Gelsenkirchen Mining Company (west Germany's largest coal producer), now heads the entire Thyssen combine.

Herr Görgen's resignation is not connected with the guarantee for the loan of DM. 80,000,000 which Phönix-Rheinrohr has requested from the High Authority of ECSC. The loan is to finance the construction of four transatlantic, ore bulk-carriers.

Imports and Exports of Iron and Steel in May

The following tables, based on Board of Trade returns, gives figures of imports and exports of iron and steel in May. Totals for the first four months of this year and last are also included.

Total Exports of Iron and Steel

Destination.	Month ended May 31.	Five months ended May 31.	
	1957.	1956.	1957.
	Tons.	Tons.	Tons.
Channel Islands	371	2,291	1,707
Cyprus	1,397	3,019	4,741
Sierra Leone	393	2,407	5,099
Ghana	1,010	11,247	8,709
Nigeria	2,544	24,302	23,877
Union of South Africa	8,898	33,365	46,562
Rhodesia and Nyasaland	5,465	34,960	28,905
Tanganyika	1,261	8,114	9,905
Kenya	5,493	22,412	23,246
Uganda	428	2,585	1,849
Mauritius	405	1,094	1,565
Aden	810	2,821	2,364
Bahrein, Qatar, and Trucial States	2,251	4,375	6,283
Kuwait	4,713	1,628	13,318
India	26,584	132,451	131,600
Pakistan	6,627	18,708	24,308
Singapore	2,418	13,455	18,254
Malaya	2,580	15,738	17,035
Ceylon	2,544	15,832	12,720
British North Borneo	370	3,013	1,786
Hongkong	6,245	25,987	43,300
Australia	17,850	99,160	89,563
New Zealand	20,313	86,185	80,312
Canada	29,755	115,770	119,160
Jamaica	3,699	10,637	10,650
Trinidad	5,249	15,676	19,571
British Guiana	1,008	2,176	3,121
Other Commonwealth countries	3,193	10,739	14,155
Eire	4,934	30,570	19,254
Finland	10,698	23,103	40,670
Sweden	10,846	53,704	48,754
Norway	10,689	35,913	50,506
Denmark	8,976	28,772	50,585
Western Germany	652	4,994	6,158
Netherlands	9,253	36,791	48,559
Belgium	4,045	18,223	17,827
France	1,629	3,648	8,196
Switzerland	1,053	6,165	8,223
Portugal	1,302	3,883	9,004
Spain	4,870	14,767	18,279
Italy	2,545	8,738	21,070
Austria	481	2,139	1,819
Yugoslavia	2	4,532	4,105
Greece	1,085	2,572	4,113
Turkey	970	1,930	2,978
Netherlands Antilles	144	4,632	1,686
Portuguese East Africa	336	1,178	2,007
Egypt	—	21,741	469
Sudan	2,553	7,226	8,009
Lebanon	144	3,962	1,409
Israel	119	4,679	1,799
Saudi Arabia	886	6,546	2,423
Iraq	2,928	15,710	16,698
Iran	11,133	34,227	27,997
Burma	2,202	2,786	8,436
Thailand	942	3,494	3,877
Indonesia	1,275	4,726	3,109
Philippine Republic	88	2,864	720
USA	5,025	20,252	21,580
Cuba	450	4,604	3,348
Colombia	833	1,320	2,039
Venezuela	11,866	29,698	45,674
Ecuador	6	1,464	1,249
Peru	379	7,535	5,524
Uruguay	503	2,050	3,450
Argentina	5,983	22,755	35,932
Other foreign countries	10,804	13,228	60,288
TOTAL	296,503	1,217,248	1,381,488

A BASIC non-contributory pension scheme has been introduced, for employees of the Scottish Stamping & Engineering Company, Limited, a member of the Guest Keen & Nettlefold group. The scheme came into operation on July 1.

Total Imports of Iron and Steel

From	Month ended May 31.	Five months ended May 31.	
	1957.	1956.	1957.
	Tons.	Tons.	Tons.
Rhodesia and Nyasaland	615	1,064	2,002
Canada	8,365	23,879	23,034
Other Commonwealth countries and Eire	1,838	2,608	10,746
Soviet Union	30,909	131,351	108,390
Sweden	2,974	20,151	14,460
Norway	10,370	43,510	54,863
Western Germany	7,602	105,038	47,676
Netherlands	1,411	49,827	21,777
Belgium	13,038	180,941	72,547
Luxembourg	1,518	30,659	14,906
France	3,067	132,844	29,526
Italy	9	5,488	1,029
Austria	9,107	78,215	34,837
Japan	1,056	7,592	6,588
USA	20,921	283,446	78,396
Other foreign countries	3,541	37,698	20,289
TOTAL	116,341	1,134,311	541,066
Iron and steel scrap and waste, fit only for the recovery of metal	101,039	410,335	326,934

Exports of Iron and Steel by Products

Product.	Month ended May 31.	Five months ended May 31.	
	1957.	1956.	1957.
	Tons.	Tons.	Tons.
Pig-iron	10,256	50,090	66,264
Ferro-columbium (niobium)	19	82	66
Ferro-tungsten	27	471	322
Other ferro-alloys	185	1,647	1,442
Ingots, blooms, billets, slabs, sheets, and tinplate bars	94	1,072	573
Iron bars, rods, angles, shapes, and sections	183	979	916
Steel bars, rods, angles, sections, and shapes	51,407	196,703	224,040
Iron plates and sheets	33	75	80
Universal plates	908	2,330	3,237
Steel plates, ⅛ in. and under ¼ in.	932	4,741	4,719
Do., ¼ in. and over	19,323	100,607	87,055
Blacksheets and blackplate	27,874	100,325	146,477
Hoop and strip	8,798	41,124	41,918
Tinplate	38,610	127,041	179,639
Decorated tinplate	299	2,997	2,043
Galvanized sheets	16,368	59,331	88,835
Other (including tinned sheets, terneplate, and ternesheets)	2,107	6,463	9,578
Railway and tramway construction material	29,460	131,330	114,415
Wire rods	5,194	17,150	22,375
Wire	9,317	43,670	47,509
Tubes, pipes, and fittings	73,838	325,601	333,326
Iron castings	128	874	821
Steel castings	347	788	1,467
Forgings	706	1,757	3,471
TOTAL	296,503	1,217,248	1,381,488

NEW STANDARDS of efficiency have been achieved by Communist China's steel industry, following the adoption of Soviet methods, according to a report by Mr. Liu Piu, Vice-Minister of the Metallurgical Industry. To-day, open-hearth furnaces produce 6.67 tons of steel per square metre of hearth area in 24 hours. This is nearly 40 per cent. higher than the rate in 1952.

News in Brief

THE Kynoch Works of the metals division of Imperial Chemical Industries, Limited, at Witton, were visited by Queen Elizabeth the Queen Mother during her visit to Birmingham and district recently.

TECALEMIT, LIMITED, announce that Mr. A. Muir, M.I.MECH.E., has been appointed manager for the Scottish and Northern Ireland region, the regional office being situated at 86, Cambridge Street, Glasgow, C.2.

TRADE RETURNS FOR MARCH of the ports of the Tees record increases in the number of ship clearances, the volume of both imports and exports, and the revenue of the port. In the last five months imports totalled 1,893,174 tons and exports 712,809 tons.

A TUNGSTEN DEPOSIT stretching out over an area of at least 10 square kilometres has been located in eastern Kwangtung province, according to the Geological Bureau of the Chinese Ministry for Metallurgical Industry. The deposit is estimated to be one of the biggest, suitable for surface operation.

A SPECIAL EFFORT to reduce industry's annual bill for corrosion losses is to be made from October 14 to 19—"National Anti-corrosion Week." A two-day convention and a three-day exhibition, both in London, will be the main features of the campaign, which is being organized by "Corrosion Technology."

PROVISIONAL FIGURES issued by the Board of Trade reveal that the value of British manufactures exported in May amounted to £302,900,000. It was the first month in which UK goods shipped overseas had exceeded £300,000,000 and it is nearly £6,000,000 higher than the previous best figure recorded in March.

FOUR 16,000-TON SHIPS are to be built at the Sunderland shipyard of Austin & Pickersgill, Limited, for London & Overseas Freighters, Limited, and a 10,000-ton motorship is to be constructed at the Sunderland yard of Bartram & Sons, Limited, for the Atlantic Shipping & Trading Company, Limited. The combined orders are worth £5,000,000.

DUE TO THE TERMINATION by the Ministry of Supply of a contract with B.S.A., Limited, for the manufacture of 30 mm. Aden guns, one of the company's Dowlais (Glam) factories is to be closed down to-day. The company will try to absorb as many workers as possible into the other Dowlais factory, which manufactures the FN rifle. It will also try to divert work from other factories.

BETWEEN 8,000 and 9,000 engineers and founders in South Wales have been granted pay increases dating from March 29. This was announced after a meeting of the Welsh Engineers' and Founders' Conciliation Board last week. Craftsmen are to get an extra 2½d. an hour, semi-skilled an extra 2¼d., and labourers 2¼d. Pieceworkers, apprentices, and juveniles will get proportionate increases.

THE 130 fuel-element shield-plugs used in the DMTR reactor at Dounreay have been produced by Savage & Parsons, Limited, Watford (Herts), in conjunction with the UK Atomic Energy Authority. The plugs are manufactured from a titanium-stabilized stainless-steel tube. Similar plugs have already been supplied to the DIDO reactor at Harwell and others have been ordered for the Australian experimental reactors.

ACQUISITION OF THE Columbia Steel Equipment Company, Inc., is to be made by the Standard Pressed Steel Company through an exchange of stock. Under the proposed acquisition agreement, 78,181 shares of common stock of Standard Pressed Steel will be exchanged for all the capital stock of Columbia Steel Equipment. There will be no change in management, personnel, or sales policies of either company.

MUCH DAMAGE was caused in a fire which occurred at a Tube Investments factory, at Oldbury, on June 23. Part of the roof of Accles and Pollock's premises which adjoin Metal Sections, Limited, where the fire was mainly concentrated, was also burned. Mr. F. C. White, managing director of Metal Sections, Limited, said that it was hoped to get production going again within a week, the chief problem being to provide overhead cover.

THE BBC'S NORTHERN FILM UNIT has been filming in Sheffield for "Breaking into Steel," one of the "Church in Action" series which will be televised on July 8. The programme focuses attention on some of the ways in which the Church ministers to people involved in the Sheffield steel industry through the Sheffield Industrial Mission. The leader of the Mission, Canon Wickham, who has been engaged on this work for 12 years, will tell viewers about it and its possibilities.

THE DIRECTORS of the South Durham Steel & Iron Company, Limited, have decided to inaugurate pension and life assurance schemes for the benefit of its male employees to become effective from January 1, 1958. Those entitled to become members of both schemes comprise full-time permanent employees who have reached their 21st birthday but have not passed their 64th birthday, and who have completed 12 months' continuous service with the company. The whole cost of both the pension scheme and life assurance scheme will be borne by the company.

A NEW COMPANY, Henry Meadows (Vehicles), Limited, has been formed by Henry Meadows, Limited, petrol, diesel engine, and gearbox manufacturers, of Wolverhampton, a member of the Associated British Engineering Group. The formation of the new company is a preparatory step, should it be finally decided to place Meadows' small-car interests under a separate division. The first of the "Frisky" light cars to be made by the company is expected to come off the production line about mid August. The capital of the new company is £50,000 in £1 shares.

SINCE INCREASES in postage rates have meant a jump from 2½d. to 4d. for letters over 2 oz., "weighing one's words" has become a practice more than ever to be encouraged. Practical encouragement for the strictly literal form of word-weighing comes from Geo. Salter & Company, Limited, who have introduced the "Weighlet," a small pocket spring-balance designed especially for checking the weight of letters. Obtainable from stationers, ironmongers and gift shops, it registers up to 4 oz. by ¼ oz., or 150 gm. by 10 gm. and when not in use it fits neatly into a 3 by 2-in. snap-fastening leather pouch.

PROMINENT among the machines to be exhibited by Wadkin Limited, Leicester, at the European Machine Tool Exhibition, Hanover, September 15 to 24, will be a range of routing and milling machines. These machines will demonstrate the progress made in high-speed metal-machining techniques, since the first Wadkin router was used experimentally for cutting light-alloy sheet nearly 20 years ago. The display will include two forms of heavy-duty radial routers, models HYR 5 and LC; a lighter type of radial router, model L.E. (with 2-h.p. head); a fixed-head router, type L.U. (5-h.p. head), and a vertical milling machine, type L.H., the latter being specially designed for fast machining of non-ferrous metals. All these machines incorporate substantial castings as a feature of the design.

Personal

Sir ALEXANDER SIM has been appointed a director of W. T. Henley's Telegraph Works Company, Limited, with effect from June 21.

Mr. J. W. WHIMPENNY, a director of W. H. Dorman & Company, Limited, oil engine manufacturers, of Stafford, flew to the West Indies on June 20.

Mr. FREDERICK COOPER, who has for some time been chief draughtsman with Tecalemit, Limited, has been appointed chief draughtsman of F. Perkins, Limited, Peterborough.

The Acme Companies announce that Mr. J. B. STRIBLING has been appointed director of Acme Ventilating, Limited. Mr. Stribling previously held the post of technical manager of the company.

Mr. THOMAS BLACK, assistant secretary of Drysdale & Company, Limited, centrifugal pump and steam engine manufacturers, of Glasgow, has been elected a fellow of the Chartered Institute of Secretaries.

Mr. W. T. MASSEY, technical adviser on tools for the General Electric Company, Limited, at Witton, Birmingham, has been presented with a television set, to mark his 60 years' service with the company.

Mr. TOM MACGREGOR, structural manager of H. Pickup, Limited, ironfounders, of Scarborough, has been appointed technical representative of the Coseley Engineering Company, Limited, Lanesfield, near Wolverhampton.

Sir NEVIL MACREADY has been appointed manager of the supply department of Mobil Oil Company, Limited, under Mr. J. A. PAUL, who, since the beginning of this year, has carried out the dual function of director and manager of this department.

Dr. D. H. WILKINSON, Reader in Nuclear Physics at Cambridge University, has been appointed Professor of Nuclear Physics at Oxford University. The professorship replaces that of Thermodynamics, which was held by the late Sir Francis Simon.

Mr. CARL A. JACOBSSON, of Sweden, has been elected chairman of the International Wrought Non-Ferrous Metals Council, in succession to Mr. H. E. JACKSON, who has retired. Mr. W. ERTEL, of Germany, and Dr. A. DE MEURON, of Switzerland, have been elected vice-chairmen.

Mr. R. T. CHAPMAN, who for the past 13 years has been personnel manager of Baker Perkins, Limited, engineers, iron, steel, and brass founders, of Peterborough, has been appointed personnel manager with Mappin & Webb, Limited, gold- and silver-smiths, of London, W.1, with effect from July 1.

Taylor's Foundry, Limited, Wharf Estate, Ealing Road, Alperton, Wembley, announced that Mr. A. F. TAYLOR has resigned as director and secretary, and Mr. R. G. TAYLOR has been appointed a director in his place. Mr. H. TAYLOR continues as chairman and is now also secretary of the company.

The following reappointments, for 12 months from June 10, to the Iron and Steel Holding and Realization Agency are announced:—Sir JOHN MORISON as chairman, and Mr. A. C. BULL, Sir THOMAS CHADWICK, Sir THOMAS FRAZER, and Mr. C. P. L. WHISLAW as members. All are part-time appointments.

Mr. J. EDWARDS, manager of the Brightside Heating and Engineering Company, Limited, London branch, has been nominated a director of the company with effect from July 1. Mr. R. I. SLATER, a director of the company, is resigning as secretary and Mr. J. R. NUTTALL has been appointed to succeed him as from July 1.

To mark his retirement, Mr. J. W. TRICKETT, secretary of the Thorncliffe Social and Recreation Association of Newton, Chambers & Company, Limited, has been presented with a cheque. The presentation was made by Mr. P. J. C. BOVILL, president of the association and managing director of the company.

Mr. G. D. ILLINGWORTH becomes labour manager of Samuel Fox and Company, Limited, near Sheffield (a subsidiary of United Steel Companies), from July 1. He succeeds Mr. B. BUTCHER, recently appointed a director. He will, in addition, be responsible for the engagement of labour, the safety and welfare departments, and for the works publications.

The Council of the British Cast Iron Research Association has appointed Mr. H. MORROGH to be deputy director and Dr. H. T. ANGUS as assistant director to Dr. J. G. PEARCE, C.B.E. (director). These two appointments take effect from July 1 and both Mr. Morrogh and Dr. Angus will continue as research manager and development manager respectively.

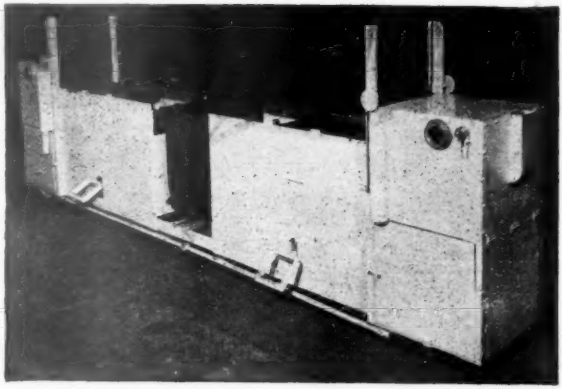
Mr. ERNEST MARKHAM, director and sales manager of Peter Brotherhood, Limited, engineers and ironfounders, of Peterborough, has been installed as president of the Whitworth Society. He gained his Whitworth Exhibition in 1915, while at Sunderland Technical College, and at the age of 62 he now becomes one of the youngest members of the Society to hold office as president.

The British Transport Commission announce that Mr. B. X. JESSOP, acting commercial manager, at Liverpool Street, Eastern Region, British Railways, has been appointed assistant traffic adviser (passenger) at the Commission's headquarters in London. The appointment is also announced of Mr. S. B. YENTIS as works-study assistant; Mr. Yentis is at present head of work-study dept., Unilever, Limited (T. Wall & Son, Limited).

Group Captain G. B. BAILEY, chairman and joint managing director of C. H. Bailey, Limited, chairman of the Tubal Cain Foundry & Engineering Works, Limited, and deputy chairman of the Atlantic Shipbuilding Company, Limited, and Mr. W. JERRERS, chief docks manager of the South Wales Ports, have been re-elected chairman and vice-chairman, respectively, of the Joint Ports Committee of the Industrial Association of Wales and Monmouthshire.

Dr. T. FAIRLEY, a director of the Park Gate Iron & Steel Company, Limited, Rawmarsh (Yorks), presented cheques, from the staff retirement scheme, to two officials who retired on June 14. They were Mr. ALFRED PARKS LUNT, chief chemist since 1930, who joined the company as an assistant chemist in 1915, and Mr. IDRIS MORGAN PRYSE, who joined the company in 1913 as senior chemist, moving to the works metallurgical department in 1923, and has lately been teaching trainees.

Mr. WILLIAM WHEELER COLEMAN has retired from the chairmanship of Ruston-Bucyrus, Limited, excavator manufacturers, of Lincoln. Mr. Coleman, who has held this position since the incorporation of the company in 1929, will retain his seat on the board and has been elected honorary chairman of the company. Mr. WILLIAM LEWIS LITLE, chairman and president of Bucyrus-Erie Company, of South Milwaukee, Wisconsin, USA, has been appointed chairman of Ruston-Bucyrus. Mr. WILLIAM SAVAGE has retired from the board of Ruston-Bucyrus after being associated with the company and its predecessors for 45 years.



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Pig-iron and Steel Production

Statistical Summary of April Returns

The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table I summarizes activities during the past six months. Table II gives production of steel ingots and castings in April and Table III, weekly average production of finished steel. Table IV gives the production of pig-iron and ferro-alloys in April, and furnaces in blast. (All figures weekly averages in thousands of tons.)

TABLE I.—*Iron and Steel Price Index and General Summary of Pig-iron and Steel Production.*

Period.	B.o.T. Price Index, 1938 = 100.			Iron-ore output.	Imptd. ore used.	Coke to blast-furnaces.	Pig-iron, ferro-alloys prod.	Scrap used in steel prod.		Steel (incl. alloy).		
	I. & S.	Coal.	Basic materials excl. fuel[1]						Imports.[2]	Prod. ingots, castings.	Delivrs. finished steel.	Stocks.[3]
1954	263	364	498	299	234	238	229	198	7	356	277	931
1955	276	399	529	311	244	246	240	213	29	381	305	1,183
1956—Nov. ..	300	470	553	328	275	262	263	234	16	426	341	1,403
Dec. ..	308	471	561	324	276	266	262	212	15	396	295	1,444
1957—Jan.[4] ..	317	475	558	346	273	267	257	224	13	416	322	1,391
Feb. ..	317	476	554	347	281	266	268	234	17	432	341	1,347
Mch. ..	317	477	552	343	298	270	277	228	17	431	336	1,358
April ..	317	477	555	329	301	273	277	223	12	430	—	1,413

TABLE II.—*Weekly Average Production of Steel Ingots and Castings in April*, 1957.

District.	Open-hearth.		Bessemer.	Electric.	All other.	Total.		Total ingots and Castings.
	Acid.	Basic.				Ingots.	Castings.	
Derby., Leics., Notts., Northants and Essex ..	—	4.4	14.8 (basic)	2.4	0.1	20.3	1.4	21.7
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire	1.5	30.7	—	2.4	0.3	33.6	1.3	34.9
Yorkshire (excl. N.E. Coast and Sheffield) ..								
Lincolnshire	—	45.6	—	—	0.1	45.6	0.1	45.7
North-East Coast	0.6	83.8	—	1.2	0.3	84.3	1.6	85.9
Scotland	2.9	47.1	—	2.3	0.4	50.8	1.9	52.7
Staffs., Shrops., Worcs. and Warwick	—	21.5	—	1.2	0.6	21.5	1.8	23.3
S. Wales and Monmouthshire	5.9	91.2	7.6 (basic)	1.0	0.2	105.3	0.6	105.9
Sheffield (incl. small quantity in Manchester) ..	7.2	35.2	—	10.0	0.3	51.2	1.5	52.7
North-West Coast	—	1 7	4.7 (acid)	0.7	0.1	7.1	0.1	7.2
TOTAL	18.1	361.2	27.1	21.2	2.4	419.7	10.3	430.0
March, 1957	20.2	357.3	27.0	23.9	2.6	419.6	11.4	431.0
April, 1956	18.0	351.5	26.1	22.7	2.8	409.5	11.6	421.1

TABLE III.—*Production of New Non-alloy and Alloy Finished Steel*

Product.	1955.	1956.	1956.	1957.	
			Mar.	Feb.	Mar.
Non-alloy steel:					
Ingots, blooms, billets and slabs[5]	4.9	4.7	5.1	5.2	5.4
Heavy rails ..	9.4	9.7	10.9	12.6	11.6
Sleepers, etc. ..	2.0	1.8	2.6	2.8	2.3
Plates, ⅜ in. to ½ in.	26.4	30.3	32.2	35.2	37.2
Other heavy prod.	47.8	50.3	55.1	54.7	55.4
Ferro-concrete bars and rods ..	7.0	7.8	8.4	7.9	8.5
Wire rods ..	22.2	22.9	26.5	24.5	22.4
Arches, etc. ..	9.6	10.1	10.6	11.8	11.6
Other light sections	36.8	41.4	44.1	44.9	43.6
Bright steel bars ..	7.8	8.0	9.3	7.8	7.1
Hot-rolled strip ..	24.1	24.5	27.9	26.2	25.2
Cold-rolled strip ..	8.1	7.5	9.2	7.0	7.0
Sheets incl. coated:					
(i) Hot rolled ..	16.6	15.0	16.4	14.1	12.5
(ii) Cold reduced	26.1	24.8	27.4	28.9	28.8
Tin and terneplate	15.6	15.9	17.1	20.2	19.4
Blackplate.. ..	1.4	1.3	1.4	1.0	1.0
Steel tubes, pipes	22.9	26.2	28.1	28.8	28.1
Tube, pipe fit'gs	0.4	0.5	0.5	0.5	0.5
Tyres, wheels, axles	4.8	4.6	5.3	5.1	4.9
Forgings (excl. drop forgings) ..	2.5	3.0	3.3	3.4	3.4
Steel castings ..	4.2	4.5	4.8	5.2	4.4
Tool and magnet steel	0.3	0.3	0.4	0.5	0.4
Total	320.6	335.0	368.0	370.4	362.1
Alloy steel[6]	15.8	17.3	20.1	18.5	17.2
Total deliveries from U.K. prod.[4] ..	336.4	352.3	388.1	388.9	379.3
Add: Imported finished steel ..	18.9	19.5	29.7	10.4	10.2
	355.3	371.8	417.8	399.3	389.5
Deduct: Intra-industry conversion[7] ..	50.9	55.2	59.4	59.5	54.6
Total new material ..	304.4	316.6	358.4	339.8	334.9

TABLE IV.—*Production of Pig-iron and Ferro-alloys during April* 1957.

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants and Essex ..	25	—[8]	27.2	20.3	0.4	—	47.9
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire ..	7	—	18.3	—	—	1.3	19.6
Yorkshire (excl. N.E. Coast and Sheffield) ..	—	—	—	—	—	—	—
Lincolnshire ..	10	—	43.2	—	—	—	43.2
North-East Coast	21	4.5	55.1	—	—	0.1	59.7
Scotland ..	9	0.8	16.1	1.5	—	—	18.4
Staffs., Shrops., Worcs. and Warwick ..	7	—	11.4	1.6	—	—	13.0
S. Wales and Monmouthshire	11	5.2	48.0	—	—	—	53.2
Sheffield	1	—	2.4	—	—	—	2.4
North-West Coast	8	19.8	—	0.2	—	—	20.0
Total ..	99	30.3	221.7	23.6	0.4	1.4	277.4
March, 1957 ..	99	31.4	218.8	25.4	0.3	1.3	277.2
April, 1956 ..	99	28.8	193.9	26.9	0.7	4.0	254.3

[1] Used in non-food manufacturing industry.
[2] Weekly average of calendar month.
[3] Stocks, mainly ingots and semi-finished, at the end of the years and months shown.
[4] Five weeks, all tables.
[5] Other than for conversion into any other form of finished steel listed.
[6] Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.
[7] Material for conversion into other products also listed in this table.

Facts from the record

of Goodyear conveyor belting

STACKER

APPLICATIONS

A super quality belting for use where there is severe and frequent abrasion and flexing. It is ideal for conveying ores, stone, coke, glass cullet and other highly abrasive materials.

PHYSICAL PROPERTIES

Stacker exceeds British Standards Grade "A" in all requirements of fabric and rubber and may be used at temperatures up to 200 deg. F.
Made with the highest grade friction stock between plies for maximum flex-life.
Has the toughest cover obtainable, with the highest possible resistance to cutting, gouging and abrasion.
Completely inhibited against mildew damage.

AVAILABLE

Stacker is available in 28, 32, 36, 42 and 48 oz. duck weights, from 3 to 9 plies and in a full range of widths, lengths and cover gauges.

STYLE ORS

APPLICATIONS

For operations where extreme resistance to oil is necessary. Especially suitable for carrying oil-sprayed co
meat, fish or food where an

PHYSICAL PROP

STYLE HRS

APPLICATIONS

Specially made for conveying hot, highly abrasive materials when the combination of resistance to high temperatures, extreme abrasion and severe flexing are essential.

PHYSICAL PROPERTIES

The carcass, cover and skim-coating between plies give all the heavy-duty characteristics of a Grade "A"

GOODYEAR
INDUSTRIAL RUBBER PRODUCTS

CONVEYOR BELTING · TRANSMISSION BELTING · V-BELTS · HOSE · FENDERING

Raw Material Markets

Iron and Steel

Overall outputs of pig-iron keep ahead of requirements, apart from the basic steelmaking grade. The supply of basic pig-iron to the steelworks appears now to cover consumption and, in fact, to provide some useful addition to stocks. With the additional furnaces which will be brought in later, adequate supplies should be available to meet the increasing steel ingot production.

The blast furnaces are well provided with iron ore and, at present, the foundries can get the grades and quantities of pig-iron of their choice, apart from the higher silicon ranges exceeding 3.5 per cent. in both the low-phosphorus and hematite irons. In the high-phosphorus irons a silicon content of up to 5 per cent. can now be secured fairly easily.

The demand for pig-iron from the foundries is mainly centred on the low-phosphorus and hematite irons, and increasing calls continue to come from the engineering and speciality foundries for the production of high-duty castings. Foundries connected with the motor vehicle trade are obtaining much higher outputs of castings, and together with the requirements of other large users, the call for pig-iron has increased proportionately. Hematite makers and suppliers of the low-phosphorus grades continue to satisfy demands. Production of the latter irons, however, is limited. Refined irons are in good supply, as is high-phosphorus pig-iron. The light foundries are only moderately employed; the textile foundries are little better off, but jobbing foundries have a fair amount of work on hand. The better grades of cast iron and machinery scrap are being taken up, and the foundries continue to receive adequate supplies of foundry coke, ganister, limestone, and firebricks.

The re-rollers have still fairly good order-books and sheet and strip re-rollers are receiving increased business from the motor-car trade. The heavy demand continues for reinforcing rods. Adequate supplies of steel semis are available and fairly good stocks are on hand. Home steelworks are keeping up deliveries at recent levels and, apart from 2-in. billets and carbon and special quality steels, there is little difficulty in getting the steel semis required.

Non-ferrous Metals

On Monday the London copper price fell to its lowest level on the London Metal Exchange since dealings were resumed in August, 1953, with the exception of the first day. This contraction in the quotation followed the announcement from the Rhodesian Selection Trust group of a reduction in its fixed price of £10 to £220 a ton. This is the second cut in just over two weeks, the first reduction was made on June 17, when the price was lowered from £240 a ton—where it had been maintained since February—to £230 a ton. In as much as the LME price was over £10 lower the price reduction was expected. The basic reason for the lowered quotation is, of course, the continued lack of consumer demand *vis-à-vis* overall production. In America the custom smelter price was also lowered, this time by ½ cent to 28½ cents a pound, equivalent to £228 a ton. This was expected as the differential between it and the primary producers' price of 29½ cents was so narrow as to warrant adjustment. The London price on Monday of less than £215 a ton adequately reflects the weak state of the market. In New York buying has been reasonable, but no more than that, and with the approach of the holiday season it will be interesting to see whether the present price line can be held. No. 2 scrap is selling for around 28 cents a pound.

In America on Monday a leading custom smelter reduced its price for zinc by a further ½ cent to 10 cents a pound, and other smelters are expected to follow suit. In London the market had been showing signs of recovering last week after the announcement of large cut-backs in production in the US, notably that from the American Smelting & Refining Company, which plans to shut down three mines and one mill, thereby reducing zinc production by 3,000 tons a month.

The weakness in the copper and zinc markets brought slack conditions to the lead market in both London and New York. In London present prices are vulnerable, but in New York the price of 14 cents a pound is being maintained without much difficulty.

Tin is the best market of the non-ferrous metals due to buffer stock buying. The price is firmish in London, while in New York it is fluctuating around 97 cents a pound.

Arizona Manganese

Results obtained by US Bureau of Mines metallurgists during extensive pilot-plant tests of processes for recovering manganese from low-grade Arizona ore are discussed in a technical report released by the Department of the Interior.

The publication is second in a series telling of the bureau's work on ore, from the Maggie Canyon deposit in the Artillery Mountains region of Mohave County. Exploration and development work at this deposit, conducted by the bureau in co-operation with private industry, outlined a 2,000,000-ton reserve of ore, assaying about 10 per cent. manganese, that probably can be mined by low-cost methods.

The report describes, in detail, eight months of testing in a 25-ton-a-day pilot plant during which various flotation processes for treating the Maggie Canyon ore were evaluated. These tests showed that by using an oil-emulsion collector, 80 per cent. of the manganese in this ore can be recovered in a concentrate assaying 35.6 per cent. manganese. Further research, to be reported later, demonstrated that this concentrate can be smelted, after sintering, to make standard ferro-manganese for use in steelmaking.

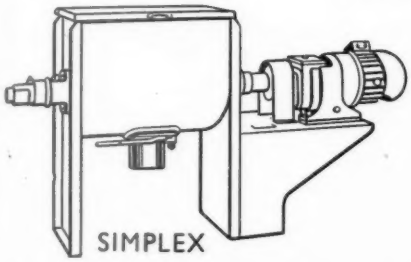
The bureau's report reviews the laboratory studies that furnished design data for the pilot plant as well as those that supported its operation. Costs of reagents used and power consumed also are given. No. 5,330, "Pilot Plant Flotation of Manganese Ore from the Maggie Canyon Deposit Artillery Mountains Region, Mohave County, Ariz.", by J. B. Rosenbaum, C. H. Schack, R. S. Lang, and J. B. Clemmer, can be obtained from the Bureau of Mines, 4,800, Forbes Street, Pittsburgh, 13, Pa.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

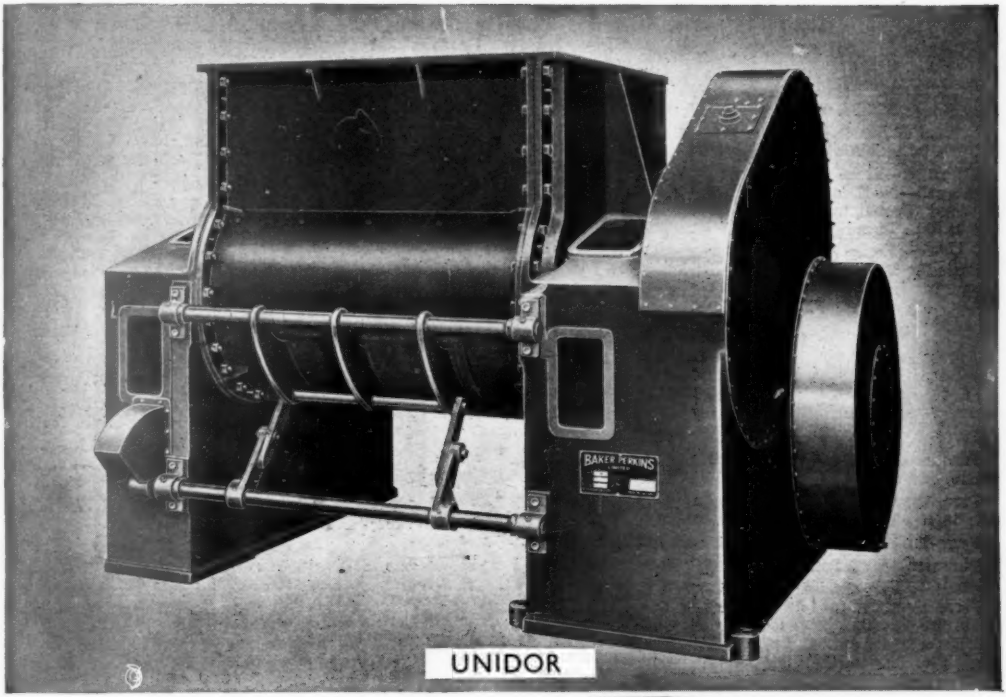
PORTUGUESE EAST AFRICA, August 1—Sand-blast plant for castings (Tender A/CFB/1/1957). Deposit $ Esc: 2,500. (ESB/14100/57.)

SOUTH AFRICA, July 10—Cast-brass base blocks for breaker trucks, for the Stores Department, South African Railways. (ESB/14485/57.)


SIMPLEX

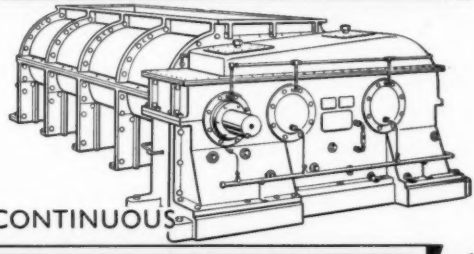
Batch and Continuous Sand Mixers

IN A RANGE OF SIZES UP TO 300 TONS AN HOUR



UNIDOR

Both "UNIDOR" and "CONTINUOUS" machines subject the sand to perfect milling action between their twin shafted, helical, contra-rotating sigma blades. Other mixers in all sizes are supplied for core sands, pre-coated resin sands and CO_2 mixes


CONTINUOUS

BAKER PERKINS LIMITED

ENGINEERS

WESTWOOD WORKS · PETERBOROUGH

Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

July 3, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £20 1s. 0d.; Birmingham, £19 13s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £21 18s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £22 2s. 3d.

Scotch Iron.—No. 3 foundry, £23 4s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £24 6s. 6d.; South Zone, £24 9s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £25 14s. 0d.; South Zone, £25 16s. 6d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £22 17s. 6d.; Scotland (Scotch iron), Zone S. 1, £23 4s. 0d.; Sheffield, £24 4s. 6d.; Birmingham, £24 12s. 0d.; Wales (Welsh iron), £32 17s. 6d.

Basic Pig-iron.—£19 3s. 0d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £53 5s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 12s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 10s. 0d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 13s. 0d. per lb. of W.

Ferro-chrome (6-ton lots and over).—4/6 per cent. C, £96 0s. 0d. to £99 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. per unit; over 6 per cent. C, £94 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 33s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr.; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3d. to 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3½d. to 2s. 3¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3¾d. to 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 0d. to 22s. 6d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £82 12s. 6d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £30 9s. 0d.; tested, 0.08 to 0.25 per cent. C, £31 9s. 0d.; hard (0.41 to 0.60 per cent. C), £32 10s. 6d.; silico-manganese, £41 0s. 0d.; free-cutting, £34 13s. 0d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £38 4s. 6d.; silico-manganese, £41 7s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £36 3s. 6d.; basic, hard, over 0.41 up to 0.60 per cent. C, £37 6s. 0d.; acid, up to 0.25 per cent. C, £40 7s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £39 2s. 0d.; boiler plates (N.-E. Coast), £41 12s. 0d.; floor plates (N.-E. Coast), £40 11s. 0d.; sectional material, N.-E. Coast, £37 11s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested (4-ton lots), £37 18s. 0d.; flats, 5 in. wide and under (4-ton lots), £37 18s. 0d.; hoop and strip, £37 17s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £41 6s. 0d.; black sheets (hand mill), 17/20 g., £52 4s. 6d.; galvanized corrugated sheets, 24 g., £65 2s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £65 10s. 3d., nickel-chrome, £92 13s. 0d.; nickel-chrome-molybdenum, £104 11s. 6d.

NON-FERROUS METALS

Copper.—Cash, £220 10s. 0d. to £221 0s. 0d.; three months, £221 0s. 0d. to £221 10s. 0d.; settlement, £221 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 1½d. per lb.; rods, 247s. 9d. per cwt. basis; 20 s.w.g., 281s. 0d. per cwt.

Tin.—Cash, £768 0s. 0d. to £769 0s. 0d.; three months, £763 0s. 0d. to £763 10s. 0d.; settlement, £769 0s. 0d.

Lead (Refined Pig).—First half July, £91 0s. 0d. to £91 15s. 0d.; first half October, £91 5s. 0d. to £91 5s. 0d.

Zinc.—First half July, £76 10s. 0d. to £77 0s. 0d.; first half October, £74 15s. 0d. to £75 0s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £108 15s. 0d.; rolled zinc (boiler plates), all English destinations, £106 10s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £90.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 9½d. per lb.; rods, drawn, 2s. 11d.; sheets to 10 w.g., 200s. 9d. per cwt.; wire, 2s. 7⅝d.; rolled metal, 186s. 6d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £152; B6 (85/15), — ; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £207; HTB2 (38 tons), £217; HTB3 (48 tons), £233.

Gunmetal.—BS1400, LG2 (85/5/5/5), £197; LG3 (86/7/5/2), £207; G1 (88/10/2/½), £262; (88/10/2/1), £257.

Phosphor Bronze.—BS1400, PB1 (AID released), £281 per ton.

Phosphor Bronze Strip, etc.—Strip, 269s. 3d. per cwt.; sheets to 10 w.g., 287s. 0d. per cwt.; wire, 3s. 10d. per lb.; rods, 3s. 2d ; tubes, 3s. 2d.; chill cast bars: solids 3s. 1½d., cored 3s. 2½d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 8d per lb.; round wire, 10g. in coils (10 per cent.), 4s. 0½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 11½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £90 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, £245; AB2, £263.

* Average 68-70 per cent.